ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

APRIL 1957
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FOUNDED 1866

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TRACKS VS WHEELS on earthmoving projects— Which do you use and when? p 87

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NEW POWER FOR CERRO — Editor's on-the-spot report from Peru's Paucartambo project. p 96

AIME at New Orleans—Papers and parties, rewards and reorganization. p 100

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91st YEAR OF PUBLICATION

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News Bureaus: Atlanta 8; Cleveland 15; Detroit 26; Houston 25; San Francisco 4; Washington 4

World News Offices: London, Frankfurt, Manila, Mexico City, Paris, Sao Paulo, Tokyo.

Published monthly with an additional issue in Mid-June by McGraw-Hill Publishing Co., Inc., James H. McGraw (1860-1948), founder. Publication Office: 1309 Noble St., Philadelphia 23, Pa. See panel below for directions regarding subscription or change of address.

Executive, Editorial, Advertising and Subscription Offices: McGraw-Hill Building, 330 West 42nd St., New York 36, N. Y. Donald C. McGraw, president; Joseph A. Gerardi, executive vice president and treasurer; John J. Cooke, secretary; Nelson Bond, executive vice president, publications division; Ralph B. Smith, vice president and editorial director; Joseph H. Allen, vice president and director of advertising sales; A. R. Venezian, vice president and circulation coordinator.

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Subscription rates for individuals in the field of the publication: United States and possessions $3 a year; $4 for two years; $5 for three years; single copy 50c. Canada $5 a year; $8 for two years; $10 for three years; single copy $1. Other Western Hemisphere and Philippines $8 a year; $12 for two years; $16 for three years; single copy $1.50. Elsewhere $15 a year; $25 for two years; $30 for three years; single copy $2.

Entered as second class matter May 24, 1951 at the Post Office at Philadelphia, Pa., under the Act of March 3, 1879. Title registered in U. S. Patent Office.

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SUBSCRIPTIONS: Send subscription correspondence and change of address to Subscription Manager, ENGINEERING & MINING JOURNAL, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Subscription Manager promptly of any change of address, giving old as well as new address, and including postal zone number, if any. If possible, enclose an address label from a recent issue of the magazine. Please allow one month for change to become effective.

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LETTERS

Aerofall Mill

Dear Sir:

I have been a subscriber to and staunch admirer of *E&MJ* for a great many years. On the strength of this, I venture to draw your attention to the small paragraph, "Aerofall Mill" on page 132 of your February issue, and suggest that you have the matter checked.

H. E. T. Haultain
Consulting Engineer
Toronto, Canada

• The paragraph to which Mr. Haultain refers, read as follows:

Aerofall mill. East Daggfontein Mines Ltd., South Africa, installed a 17-ft dia mill, cut operating cost 4.97 shillings per ton (over 10% reduction in over-all working cost to mine and mill). In addition, recovery of uranium went up from 79 to 88.5% and sulphuric acid use dropped by 35%.

This reference is incorrect as Mr. Haul-

(Continued on p 103)

B.F.Goodrich

13 years and 25 million tons with B.F.Goodrich cord belts

EACH day, during the mining season, thousands of tons of jagged iron ore are dumped on the B.F.Goodrich cord belts (inside housing shown above) in one of the largest mines on the Minnesota Iron Range. Three B.F.Goodrich cord belts then carry the ore 1,400 feet up to railroad cars. In 13 years, these belts have handled almost 25 million tons of iron ore and still have an estimated 3 more years of service left.

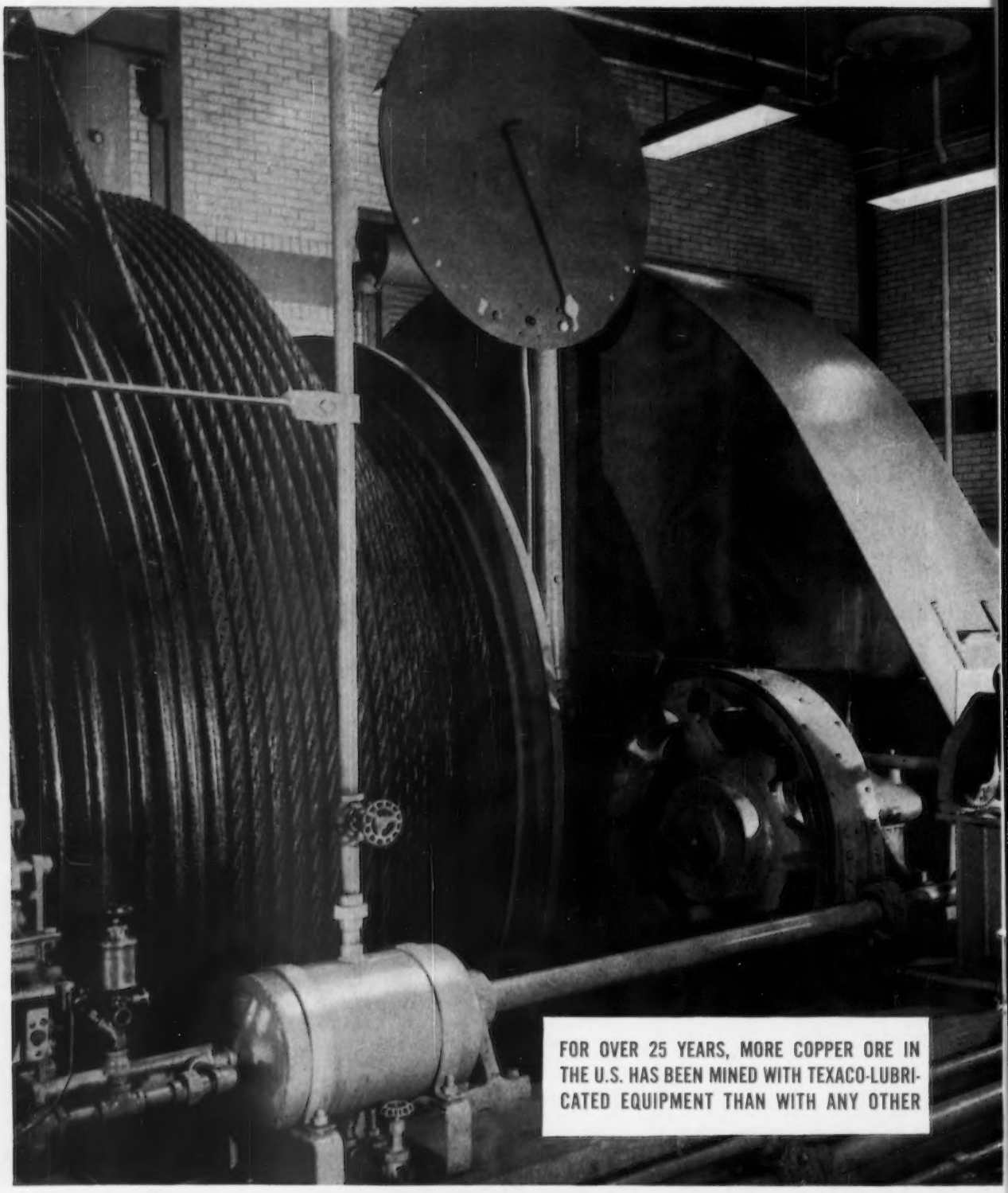
The ability to stand heavy impact and carry heavy loads long distances is built into the B.F.Goodrich belts. Cords running lengthwise, without cross threads binding them together, are surrounded by rubber. They are free to "give" on impact, with rubber taking the shock. Absence of binding crossweave in the B.F.Goodrich belt allows the lengthwise cords to flex. As a result, the cord belts conform to idlers, pulleys. Spillage is reduced, troughing is natural and belt keeps centered on idlers, sustains less damage, requires less maintenance.

As an extra protection against shock and impact, B.F.Goodrich puts a patented *Transcord Breaker* in conveyor belts. This extra layer of parallel cords in rubber is placed across belt width and around belt edges. This increases the adhesion of cover to carcass by 50%. It keeps the belt cover from tearing off carcass under severe impact, and prevents gouges and cuts from splitting the belt cover.

Any conveying operation that submits a belt to punishing impact at the loading chute, heavy loads with long centers and high lifts, can use B.F.Goodrich cord belts. Your B.F.Goodrich distributor *can* give you full information. *B.F.Goodrich Industrial Products Co., Dept. M-918, Akron 18, Ohio.*

B.F.Goodrich

INDUSTRIAL PRODUCTS



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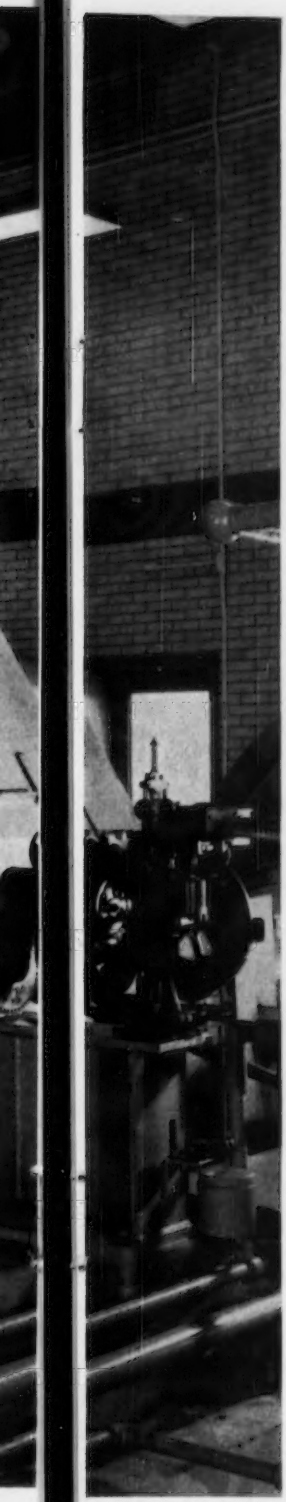
every Saturday afternoon

TEXACO

TEXACO



Keep wire rope as strong as the day you bought it

Here's proof it can be done: *One operator (name on request) reports on a 3,100-foot wire rope that had been lubricated exclusively with* ***Texaco Crater:*** *"After some two years' service... we sent a sample of the rope to the manufacturer for testing. The report on the test showed the rope to be perfectly lubricated and to have* ***more tensile strength than guaranteed when sold to us."***

TEXACO CRATER penetrates quickly, surrounds each metal strand with a tough film that prevents rust, greatly reduces wear. In addition, *Texaco Crater* forms a protective seal around the core. This double action is what keeps rope strong longer.

Texaco Crater is also ideal for open gear lubrication. It eases the strain of extra heavy loads and minimizes wear—so gears run smoother, last longer, cost less for maintenance.

When conditions make spray application more practical, use *Texaco Crater X Fluid*. On both wire rope and gears, it does the same outstanding lubricating and protective job as regular *Crater*.

For mine car wheels, use *Texaco Olympian Grease*. It resists stiffening, even in coldest weather. Assures easier starts, full bearing protection, lower costs.

Let a Texaco Lubrication Engineer help you raise efficiency, reduce costs. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

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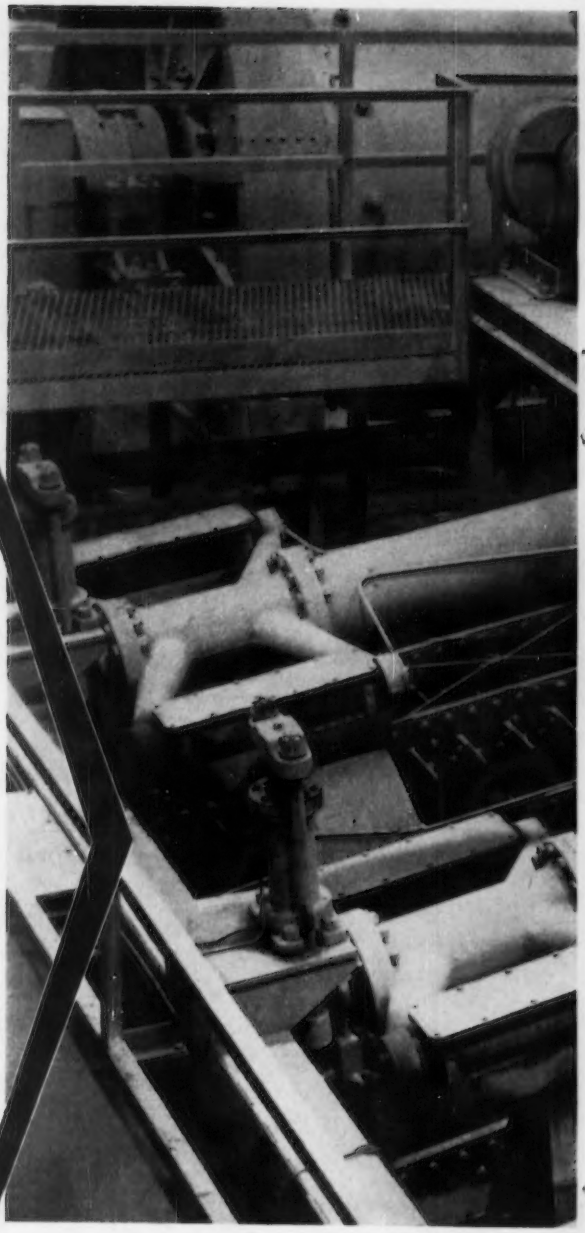
The Texas Company, 135 East 42nd Street, New York 17, N. Y.

Lubricants and Fuels
FOR THE MINING INDUSTRY

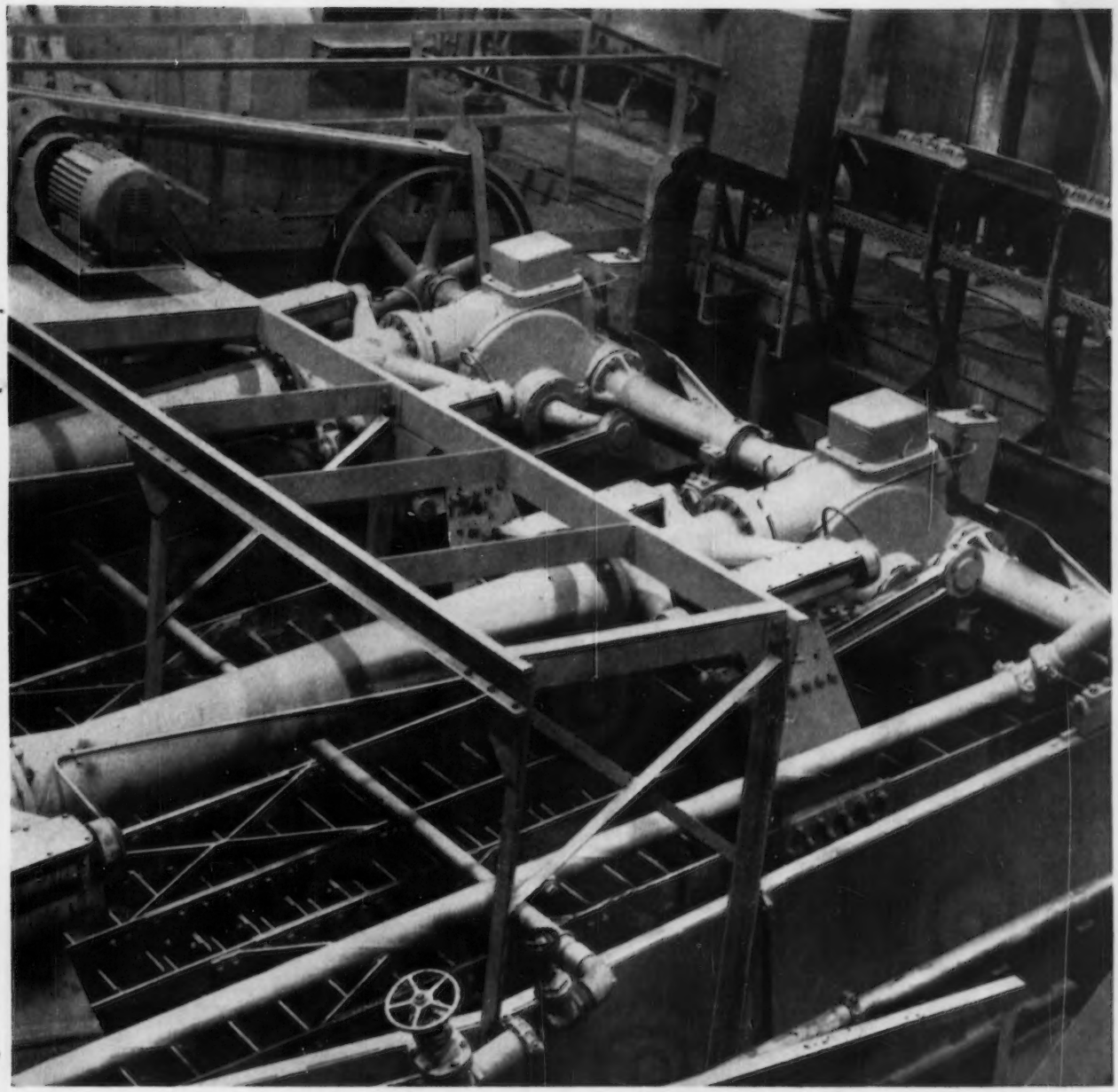
Idarado Mining Co. Classifies Complex Ore Body with DORR heavy duty Classifier



Rocky Mountain Mill Beneficates 1750 TPD of complex ore containing copper-lead-zinc-gold and silver

Situated high in the Rocky Mountains in Colorado almost 9000 feet above sea level, the Pandora Unit of the Idarado Mining Company has encountered one of the most complex ore bodies in the Western United States. Consisting mainly of copper, lead, and zinc sulphides, the ore also contains recoverable fractions of gold and silver.

In the Pandora flowsheet an 8′ x 12′ rod mill receives 1750 TPD of minus 1″ copper-lead-zinc-ore. The rod mill discharge is jigged to recover gold and silver which is then sent to



amalgamators. The balance of the rod mill discharge, which is approximately 30% minus 65 mesh, overflows to the Dorr Quadruplex Classifier. The Dorr Classifier, which is 16′ wide by 28′ long, is in closed circuit with ball mills and produces a 65 mesh separation at an overflow solids concentration of 35%. Overflow product goes to a conventional flotation circuit for subsequent recovery of the copper, lead, and zinc values.

For more information on Dorr HX Classifiers, write for a copy of Bulletin No. 2281. Dorr-Oliver Incorporated, Stamford, Connecticut.

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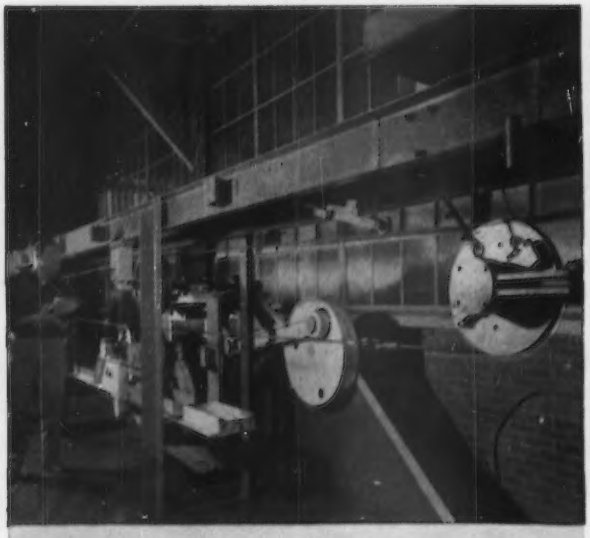
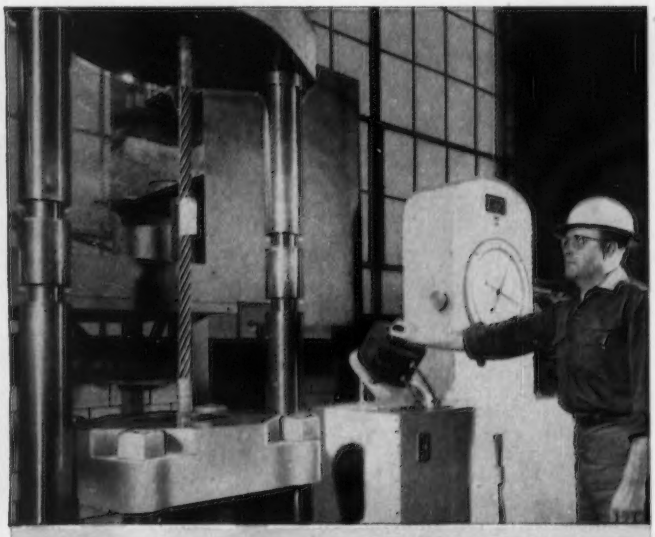
Why J&L wire rope service life

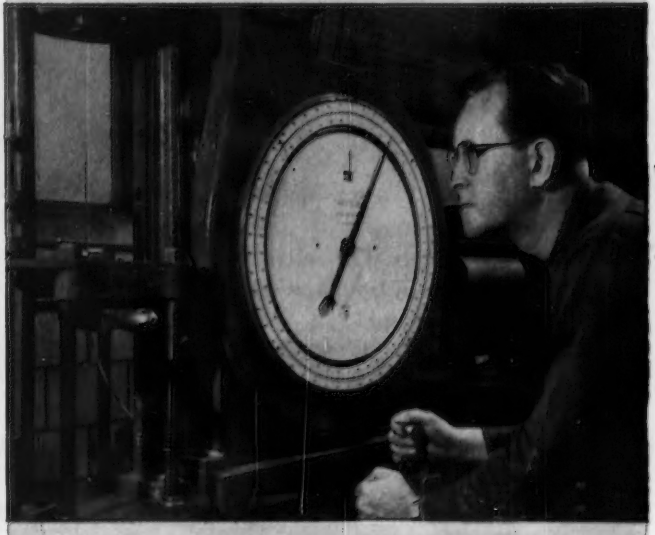


Fatigue machine. This 6 x 25 I.P.S. fiber core rope is being subjected to a continuous fatigue test to determine the number of reversed bends before breakage.



Cross-section tension test. This 1¼" 6 x 41 I.P.S.-RL fiber core rope was tested to 140,000 lbs. tensile load. Catalog requirement for same rope is only 123,000.

Vibration fatigue test subjects this boom pendant assembly to repeated shock loading. The 2,500 ft. lb. load provides action simulating actual field conditions.



Tension test of individual wires shows pounds of tensile load withstood before breaking. Every coil of wire used in J&L wire rope is thoroughly tested before acceptance.

salesmen can talk with confidence

To users and buyers of wire rope, safety and long rope life are all-important considerations. When you specify J&L, you can be confident you are buying wire rope that will stand up to the job for which it is made.

Every strand of J&L wire, every finished wire rope, is subjected to exacting tests to determine maximum factors of strength, flexibility, abrasion and corrosion resistance. This quality control is a most important operation in the production of J&L wire rope. Shown here are some of the tests that enable your J&L wire rope salesman to talk about quality with confidence.

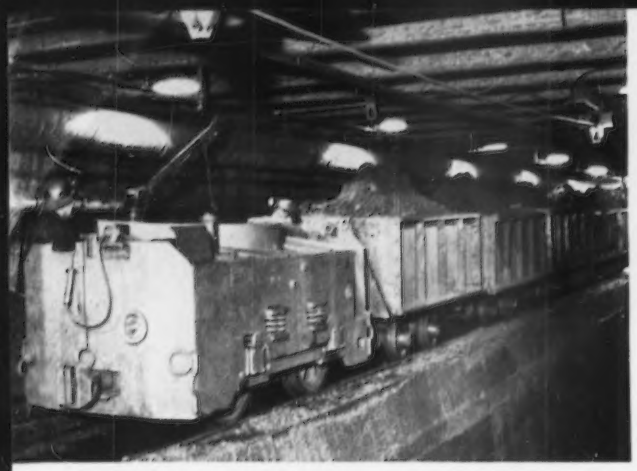
The next time you buy wire rope, call your nearby J&L representative, or write direct to the Jones & Laughlin Steel Corporation, Wire Rope Division, Muncy, Pennsylvania.

Jones & Laughlin
STEEL
. . . a great name in steel

Torsion machine tests ductility by twisting wire. This 8" length of .081 wire took 41 revolutions before snapping. Federal standards require only 26 revolutions.

Wrap test. Galvanized wire is wound eight times around a mandrel of its own diameter and then unwrapped, proving ductility of wire and the bond of the coating.

(Protective screens removed during photography.)



1. TROLLEY-CABLE REEL—Built in 4-8 ton sizes, opened or sealed types, these versatile units can do gathering jobs quickly, economically. Centrally hung motors and equalized spring suspensions help prevent rail pounding, climbing.

2. TROLLEY—Fast, powerful, safer, and easy on the track, this heavy-duty haulage locomotive is available in eleven sizes, 4 to 40 tons, low height or standard. Requires little maintenance, is of sturdy, rugged construction.

3. STORAGE BATTERY—In sizes from 1½ to 10 tons, this type unit gives highly reliable, efficient, safer service for operations where trolley wires are not feasible. Battery eliminates stand-by losses, delays due to power failures.

4. DIESEL-ELECTRIC—G.E.'s powerful diesel-electrics are available in seven standard sizes, 25 to 80 tons . . . are ideal for surface haulage and switching operations. Electric drive gives them long life, dependability.

A General Electric locomotive matched to your needs gives you fast, efficient, low cost mine haulage

Whatever your mine haulage or gathering requirements, there's a General Electric locomotive that will suit your needs. Whether for underground or surface haulage, a G-E straight-electric or diesel-electric locomotive can haul your loads faster and at reduced costs.

General Electric offers a complete standard line of sturdy, dependable industrial and mine locomotives—available in a full range of sizes, heights, widths, and track gauges. Typical of these G-E locomotives are the four types shown above.

G-E locomotives have proven their efficiency in thousands of mine and industrial applications under extremes of moisture, temperature, dust, and track conditions. You can expect this same efficient, highly reliable performance from a G-E locomotive that is matched to your mine's requirements. High availability and low maintenance costs mean that G-E locomotives can do your haulage jobs better . . . faster . . . more economically.

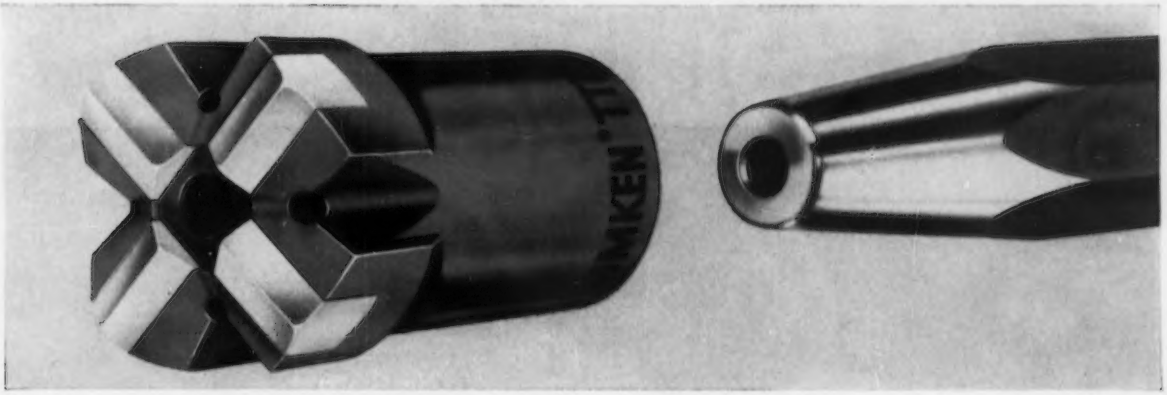
FOR MORE INFORMATION about G-E industrial and mine locomotives, or for a survey of your particular haulage needs—without cost or obligation—contact your nearest G-E Apparatus Sales Office. General Electric Company, Locomotive and Car Equipment Department, Erie, Pa. 120-94

Progress Is Our Most Important Product

GENERAL ELECTRIC

New Timken® bit for air-leg drills and light stoping...

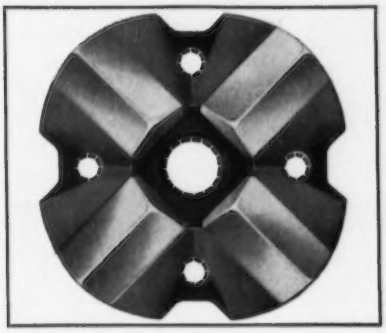
REMOVABLE for full steel life
TAPERED for more secure union



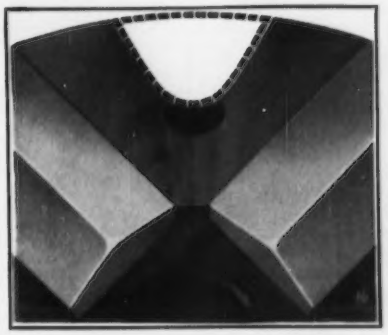
Here's how you can get lower cost per foot-of-hole with the new Timken® tapered socket bit. It's removable! Simply take off the old bit, put the new one on the same drill steel. No need to throw away the steel when the bit is used up. You can drill out the full life of every steel, cut your reconditioning costs to a minimum. And with its uniformly tapered socket the new Timken removable bit provides a more secure union than threads for feed-leg drills. Precision-made, the taper fits tight to the drill steel, reduces breakage, helps this new Timken bit lower your cost per foot-of-hole.

The bit body is made of special analysis Timken electric furnace fine alloy steel—giving you the finest in physical properties obtainable in a rock bit today. Special analysis carbides give the Timken tapered socket bit superior wear-resistance with added shock-resistance. It holds its gauge longer, drills faster, can be reconditioned many times. And it's available in three popular sizes: 1¼", 1⅜", and 1½". Send for free brochure today. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

TWO NEW FEATURES CLEAR CHIPS FASTER



NEW 5 FRONT HOLES direct water against face with jet-action velocity to wash away chips faster. Larger center hole has plug dropped deeper for freer cutting action, less drag on bit.



WIDER, DEEPER CLEARANCE works in unison with five front holes to remove chips speedily from cutting face. This faster chip flow speeds drilling, makes cutting more efficient, adds life to bit.

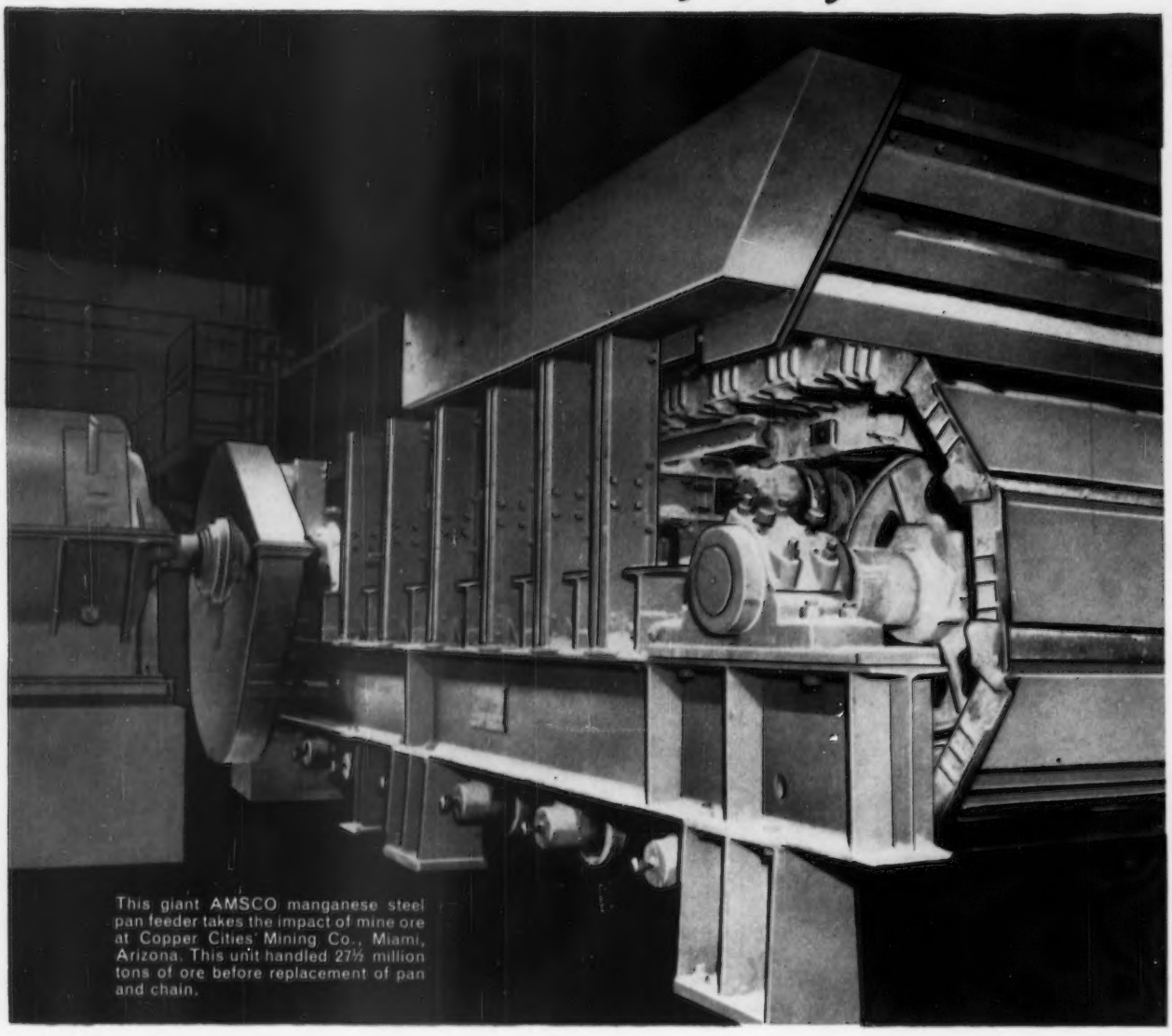
TIMKEN MULTI-USE BIT (left) with correct, controlled reconditioning gives lowest cost per foot-of-hole when full increments of steel are used. **NEW TIMKEN THREADED CARBIDE BIT** (right) for other tough jobs. Improved thread contact reduces breakage. New wear-resistant carbides add life.

TIMKEN REMOVABLE ROCK BITS

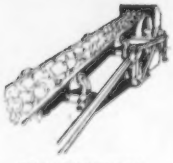
TRADE-MARK REG. U. S. PAT. OFF.

STEPHENS-

heavy duty ahead



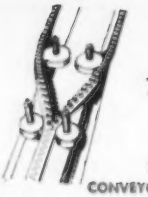
This giant AMSCO manganese steel pan feeder takes the impact of mine ore at Copper Cities' Mining Co., Miami, Arizona. This unit handled 27½ million tons of ore before replacement of pan and chain.



BELT CONVEYORS

VIBRATING CONVEYORS

REDLER CONVEYORS, ELEVATORS



ZIPPER CONVEYOR-ELEVATORS

PAN CONVEYORS

BUCKET ELEVATORS

BIN GATES—ALL KINDS

-ADAMSON

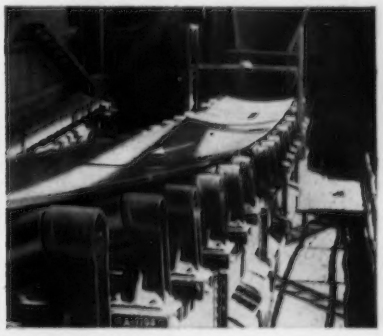
for your ore conveyor system

How will you move a lot of ore under or over the ground, thru processing, in and out of storage, to and from shipping—move it fast, at the least cost?

Mechanization is the way, the S-A way, and it's done by close prior study of your requirements by the best engineering brains in the bulk material conveying industry. These men are backed by a quality line of material handling and conveying equipment designed to move any type of ore in any quantity.

Long range planning of your ore handling needs is important. This calls for a conveyor system engineered for the years to come. You can find these kind of STEPHENS-ADAMSON systems everywhere in the world, moving all kinds of ore products at rock bottom cost.

Wherever you are, S-A engineers can design, build and install your conveyor system. They are available to work with your engineers or with your consultants.



A South American copper mine has been using an S-A system for 25 years. The original installation totals 18,485 feet and in terms of ore delivered is in the multimillion ton class. Six Amsco feeders are included in the system. S-A carriers, probably the largest ever built, weigh almost 1000 lbs. each.

Handling a wide variety of zinc ores, a complete S-A system conveys to storage by means of feeders, bucket elevator, shuttle conveyor, and centrifugal pilers. SACO speed reducers are used on all conveyor drives and spring type belt wipers keep belt surfaces clean. Close-up here shows centrifugal thrower.

SINCE 1901 S-A STEPHENS-ADAMSON MFG. CO.

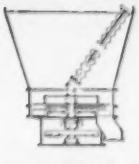
STEPHENS-ADAMSON MFG. CO.

4 RIDGEWAY AVENUE, AURORA, ILLINOIS

LOS ANGELES, CALIFORNIA

BELLEVILLE, ONTARIO

VIBRATING SCREENS



CIRCULAR BIN DISCHARGERS

SEALMASTER BALL BEARING UNITS

S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

- Belt Conveyors
- Belt, Pan & Plate Feeders
- Ship Loading Boom Conveyors
- Stacking Conveyors
- Storage & Reclaiming Systems
- "Natural Frequency" Vibrating Conveyors
- REDLER Conveyor-Elevators
- ZIPPER Conveyor-Elevators
- Conveyor Belt Cleaners
- Headshaft Holdbacks
- Grizzlies & Screens
- Centrifugal Pilers
- Bin Gates & Tunnel Gates
- Car Pullers & Spotters
- Bucket Elevators
- Skip Hoists
- SEALMASTER Ball Bearing Units

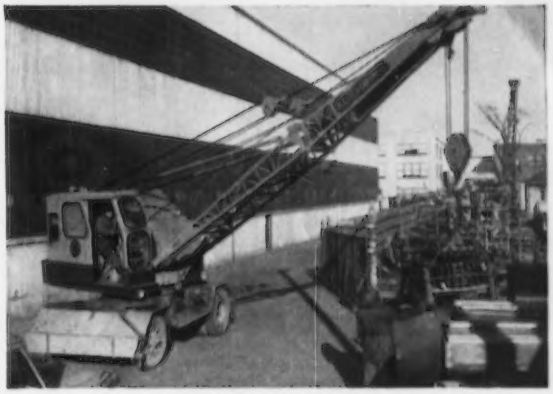
• *Write for a bulletin on any of the above products.*

KOEHRING WORK CAPACITY *in action . . .*

Quarry rock — Take another look at the heavy-duty shovel (above), loading rock at a Midwest quarry. It's the new Koehring ¾-yard 305, with 18-foot deep-section boom, and 15-foot dual dipper-sticks. In heavy digging like this, operators like the light lever-pull of its big power clutch, and accurate "feel" of load. *You'll* like its *extra work capacity* with all attachments, on crawlers or rubber (see ratings on next page).

Mining phosphate — After stripping overburden at a Southern mine (right), 605 dragline loaded phosphate out of the deep cut. It has plenty of work radius for this type of operation — can be used with 50 to 110 feet of boom, and handles 1½ to 2½ cu. yd. dragline or clamshell buckets, depending on weight of materials. Better check what this big Koehring 605 can do on your excavating, lifting and material-handling.

21.5 m.p.h. Cruiser® — One man controls all operations, one engine supplies all power for work and travel on the new Koehring 205 Cruiser Crane. There's a full range of low working speeds to 7 m.p.h. — plus travel speeds up to 21.5 m.p.h. Has smooth torque-converter drive, power-steering, climbs 30% grades. Usefulness is unlimited in mines, pits and quarries. It lifts up to 15 tons — handles ½ to ¾-yard clamshell or dragline buckets — converts to shovel or hoe. Versatile Koehring 205 also is available on truck mounting or on heavy-duty crawlers (more details below).



Stockpile specialist — Owner of this yard put stockpiling on a big-tonnage basis with a 405 clamshell crane. Its smooth swing, fast line speeds, and wide work radius pay off on all kinds of material-handling. This 405 is another in the modern, new series of Koehring excavators and cranes. Want more information? Call your Koehring distributor today.

Here are some figures that will interest you:

KOEHRING MODEL	SIZE DIPPER	LIFT CAPACITIES (Crawler ratings based on 75% of tipping load. Rubber-tired machines — 85% of tipping load.)	
205 CRAWLER	½-Yd.	20,000 lbs.	at 10-foot radius
205 ON RUBBER	½-Yd.	30,000 lbs. 13,700 lbs.	at 12-foot radius at 20-foot radius
305 CRAWLER	¾-Yd.	30,000 lbs.	at 12-foot radius
305 ON RUBBER	¾-Yd.	50,000 lbs. 15,800 lbs.	at 10-foot radius at 30-foot radius
405 CRAWLER	1-Yd.	40,000 lbs.	at 12-foot radius
605 CRAWLER	1½-Yds.	72,300 lbs.	at 12-foot radius
1205 CRAWLER	3-Yds.	190,000 lbs.	at 13-foot radius

KOEHRING COMPANY Milwaukee 16, Wis. Subsidiaries: JOHNSON PARSONS • KWIK-MIX

THE ORE-MASTER UNDERGROUND DUMP TRUCK

SPECIALLY DESIGNED FOR LOW HEAD ROOM and NARROW DRIFT AREAS

This rubber-tired, rugged, heavy duty unit has proved a valuable aid to higher production and lower underground haulage costs. It helps get that extra load or two per working shift for each truck through fast dumping and fast body return to down position.

Some of the service features are: This unit operates with lower maintenance costs than any other ore-hauling device now being used. It will perform in 8' x 8' drifts and have room to spare. It can carry 12,000 pounds of pay load quickly and efficiently. This unit with three speeds in either direction enables the heading to be worked without turning the truck around.

WRITE FOR COMPLETE DETAILS

• SPECIFICATIONS

Description—

Engine: GM Diesel Engine, Model 2055C (2-71)—or Model 43300 (4-51)
Other engines available on special order.

Transmission: Allison—CRT 3330-3
Lubrication; Type—Full Pressure Capacity—7.5 gal.

Torque Converters: Allison—TC 320 Single Polyphase
3.50—1 Ratio 4-Element
Built-in braking features with Drive line parking brake with brake lock.

Clutch: Multiple Disc Type; sintered bronze—steel core Hydraulic actuated—automatic wear compensation

Brakes: Bendix-Westinghouse-Air—rear only

Cooling System: 12 quart capacity—Harrison fin and tube type construction

Steering Gear: Worm and Gear

Tires: Nylon Rock Grip Excavator 7.50 x 15—12 ply

Springs: (front and rear) Heavy duty built up with extra leafs. Semi-Elliptic Type; Mounting—Shackle—both ends

Fuel Tank: 17 gallon capacity

Dimensions:

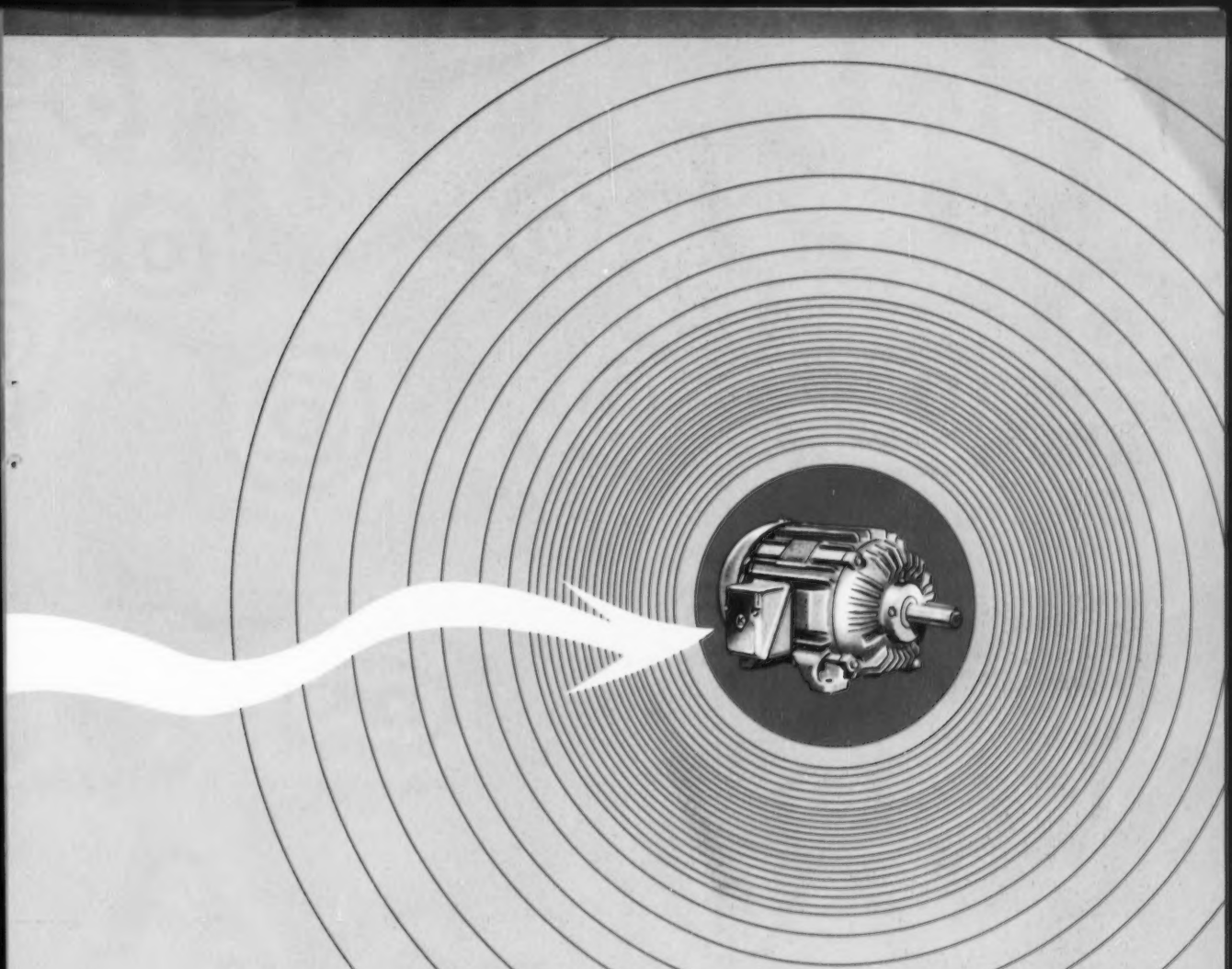
Wheel base	123″
Turning Diameter ..... right 50′	
Area to turn—180°-40′x40′ left 47′	
Over-all length	18′ 0″
Over-all width	6′ 6″
Over-all height	5′ 6½″
Loading height (top of body from ground)	4′ 6″
Wheels and body removed:	
Length	15′ 11½″
Width	5′ 6½″
Height	4′ 2″
Length of body—inside top	108″
over-all	118½″
Width of body—inside top	73½″
over-all	74″
Depth of body—inside front	1′ 4″
Road Clearance—minimum	8″
Height of body in dumping position	10′ 2″

Speed: MPH, loaded
Forward: 3.4 1st; 9.4 2nd; 27.2 3rd
Reverse: 3.4 1st; 9.4 2nd; 27.2 3rd
Maximum speed on a fifteen per cent grade with heaped truck load 5-7 MPH (Maximum recommended for underground)

Body Capacity:
Struck loaded—6 tons

F.O.B. shipping point—St. Louis, Missouri
90 day warranty on all parts with exception of Engine and Transmission which carry manufacturer's standard warranty.

ORETRUCK MFG. DIVISION
ORETRUC, INC., MT. CARMEL, ILL.
SALES OFFICE • 326 South Grand, St. Louis 3, Mo.



The real cost of MOTORS

The cost of a motor extends over its entire lifetime. It does not end with purchase price. Cost *goes up* with every shutdown, every motor maintenance stoppage. Cost *stays down* when you buy quality. And quality means Allis-Chalmers.

All of these extras that don't show on the Allis-Chalmers nameplate — more copper, more iron, more cooling provisions—exemplify the quality-craftsmanship that goes in before the price tag goes on.

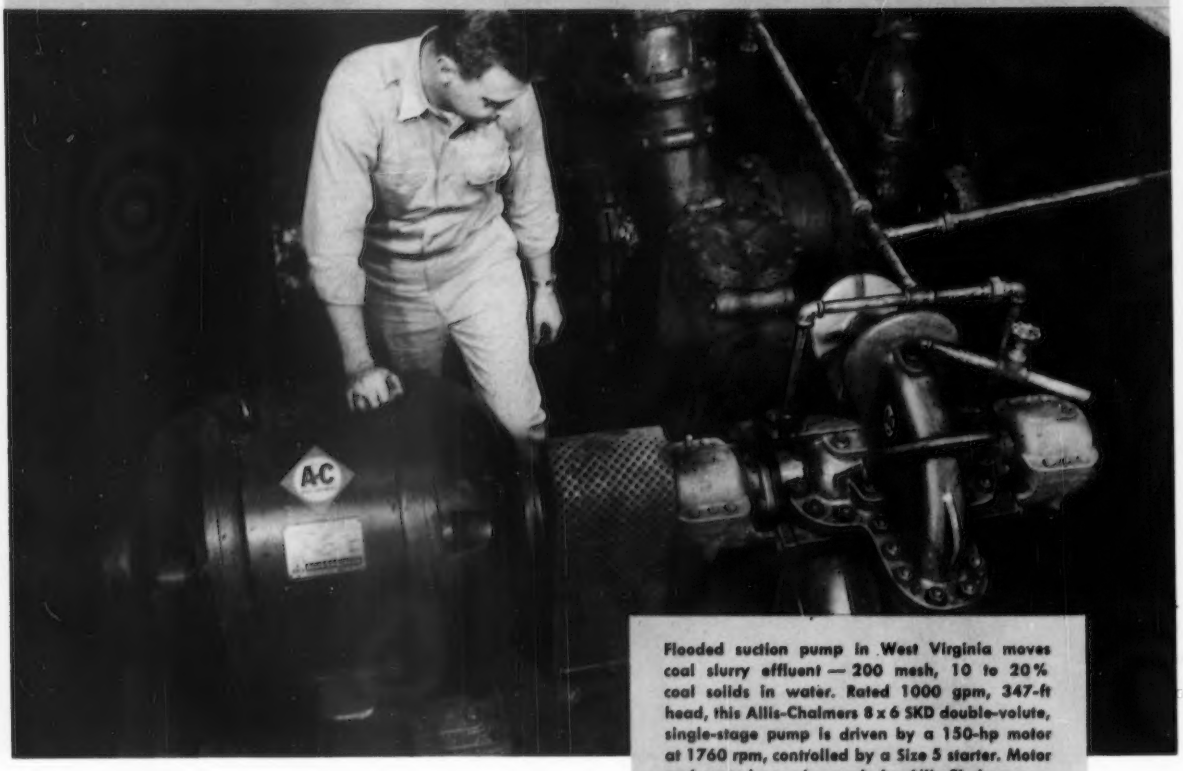
For the "long run," either as a new machinery component or as replacement, specify Allis-Chalmers. Find out more about *real* quality in motors from your A-C district office or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS CHALMERS

A-5287

Coal-Washing Savings with Allis-Chalmers Pumps



Flooded suction pump in West Virginia moves coal slurry effluent — 200 mesh, 10 to 20% coal solids in water. Rated 1000 gpm, 347-ft head, this Allis-Chalmers 8 x 6 SKD double-volute, single-stage pump is driven by a 150-hp motor at 1760 rpm, controlled by a Size 5 starter. Motor and control are also made by Allis-Chalmers.

Custom-Assembled Pump Costs Less than a Standard Pump

Nodular iron, developed by Allis-Chalmers, cuts the cost of this pump. The ribbed casing was cast in *nodular* iron — it has the tensile strength of the standard pump made of steel but costs considerably less. Adjustable wearing rings are made of stainless steel. This application typifies Allis-Chalmers ability to custom-assemble liquid and solids handling pumps from standard components made of a wide variety of metals and alloys — to meet any conditions of temperature, corrosion and abrasion.

You Get MORE Pump Value... When You Specify Allis-Chalmers

... because Allis-Chalmers pump development is based on extensive experience gained in supplying standard and special pumps to all industries for many years.

... because you specify from the world's widest pump range (1½ to 72 inches).

... because you get pump application and engineering advice from experts anxious to help you.

and MORE

... because Allis-Chalmers is the only company that offers pump, motor, drive and control as a unit, designed to work together — all built by one source, for "one source" responsibility.

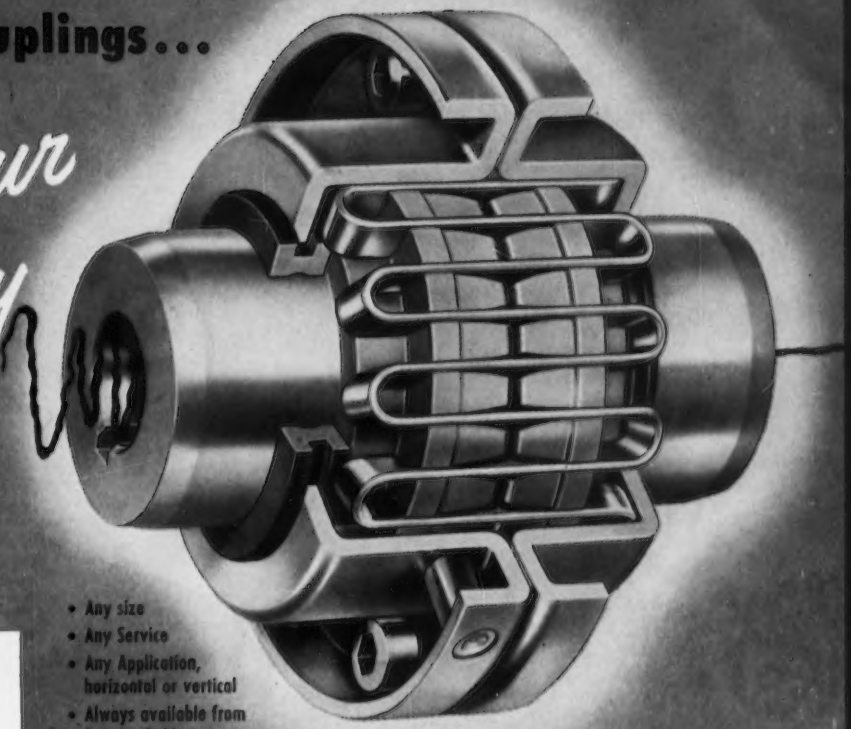
For detailed pump information contact your local A-C office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

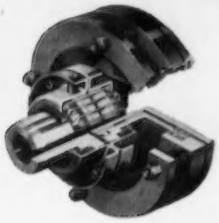
A-5305

Falk Steelflex Couplings...

Protect your machinery in 2 ways



- Any size
- Any Service
- Any Application, horizontal or vertical
- Always available from factory, field or distributor stocks

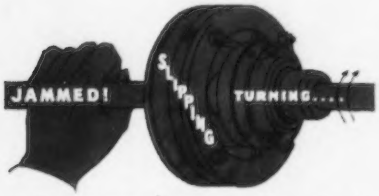


Falk Controlled Torque Couplings prevent damage from overloads

In applications where danger from overloads exists, use the FALK Type FT Controlled Torque Coupling. The Type FT has all the features and advantages of standard FALK Steelflex couplings—and, in addition, has an adjustable friction slip clutch, enabling the operator to set the coupling to slip at any predetermined overload.

This controlled-torque principle not only prevents transmission of dangerous shocks and limits overloads; it eliminates the breaking of shafts caused by jamming of driven equipment.

An outstanding advantage of the Type FT Coupling is that, as soon as the cause of the overload is removed, the entire coupling will rotate and transmit power without replacing parts or repairing coupling.



There's real economy in using Type FT Controlled Torque Couplings. Many users have reported that these couplings paid for themselves the very first time they slipped (under overload) because of the protection against damaged driving or driven machinery!

...cost less per year of service!

You get *double protection* when you connect your driving and driven machinery with a Falk Steelflex Coupling—the all-steel coupling with the exclusive grid-groove design! First, its *torsional resilience* smothers shock and vibration; and second, the Steelflex design prevents damage and lowered efficiency by accommodating shaft misalignment.

Why have increasing numbers of key men in industry standardized on Falk Steelflex Couplings? Their experience has proved that Falk Steelflex Couplings prolong the service life of their machinery... are trouble-free and need minimum maintenance... are easy to install, lubricate and disconnect... and *cost less per year of service* than ordinary couplings.

One basic Steelflex design—the type F, in its many sizes—is adaptable to more than 90% of all industrial applications. For applications involving danger from overloads, Modified Type FT Controlled Torque couplings (see column at left) are ideally suited. There are numerous other special or dual purpose Steelflex couplings for unusual applications. **Write to Department 247** for engineering bulletin, including selection and dimension tables.

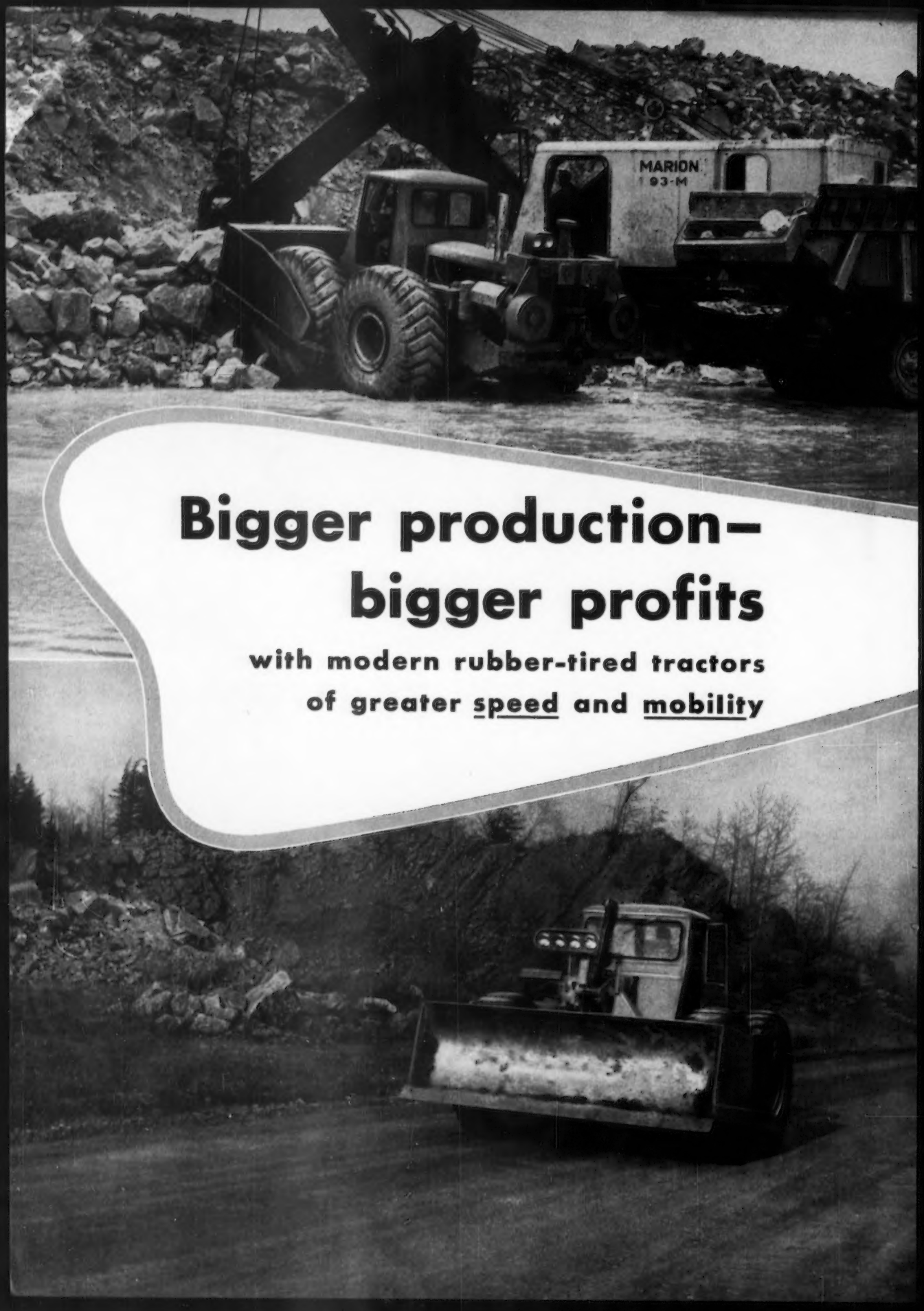
THE FALK CORPORATION, MILWAUKEE, WISCONSIN

FALK

...a good name in industry

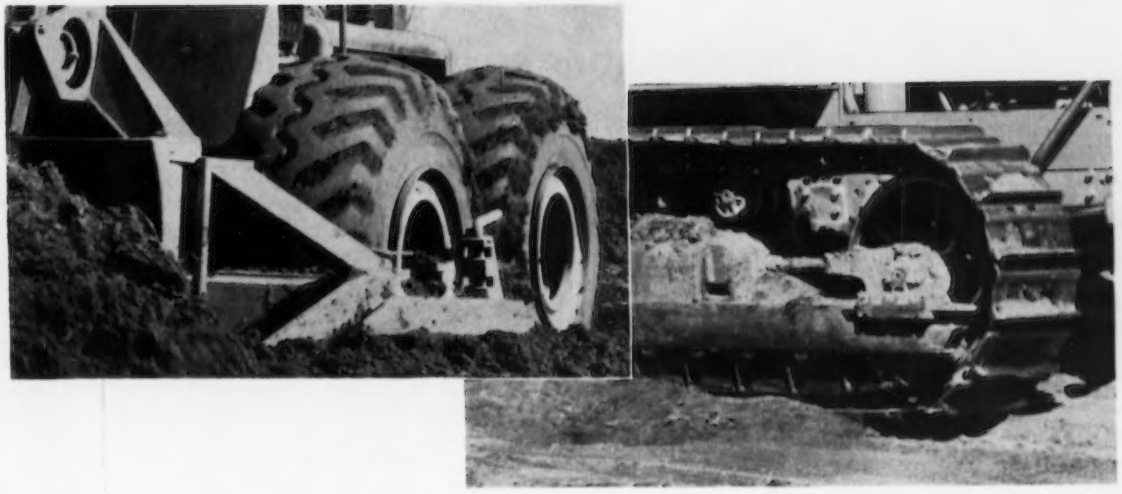
MANUFACTURERS OF:

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining



Bigger production— bigger profits

with modern rubber-tired tractors of greater speed and mobility



Today's needs demand tractors that have 4 major dimensions

Your tractor requirements for work around pit and plant have changed considerably during the past few years. Time was when you could evaluate tractors on their drawbar pull or push — a combination of engine horsepower and the amount of traction developed. These 2 dimensions — *power and traction* — gave you the necessary performance to handle clean-up around yesterday's shovels . . . let you strip topsoil and level fill, in step with the production needs of that time. Fast dozing cycles, and the ability to speed from one assignment to another, were not considered essential back in the days of lower wages and longer time limits.

But today, with larger pits, big-capacity shovels (where clean-up interruptions are costly), and the demand for higher efficiency on stripping and maintenance work, *two new dimensions* are added to your tractor requirements. These extra dimensions are *speed* and *mobility*. Bigger shovels, with high operating cost, demand that clean-up delays be kept to a minimum. Higher production demands, to meet competition, require more speed all the way . . . from stripping overburden to leveling dump areas . . . pulling or pushing scrapers . . . towing equipment, and other tractor assignments.

With the trend to bigger pits and more widely scattered operations, *mobility* must be added to speed for efficient tractor operation. To handle scattered assignments economically, your tractor must be able to run — not crawl — from job-to-job under its *own* power.

Track-type tractors can capitalize fully on two of these dimensions — power and traction. Over the years they have become so universally well-recognized that a wide selection of track-type tractors, ranging in size to 436 hp, are offered by various manufacturers.

A few of these present-day heavy track-type tractors approach the third dimension — speed — in their work range. But a big track-type tractor that successfully utilizes the fourth dimension — *mobility* — is not yet available to meet today's need.

That is why you must think today of tractors in terms of *all four dimensions* . . . power — traction — speed — and *mobility* . . . to determine which of today's tractors will give you the greatest return on your investment.

To help you in your analysis of these heavy-duty tractors, and the extent to which they can measure up to your requirements, study the information presented on the following pages which explain in detail your need for

1. POWER

2. TRACTION

3. SPEED

4. MOBILITY

Before you buy, check all four dimensions. ▶

Dimension 1

POWER

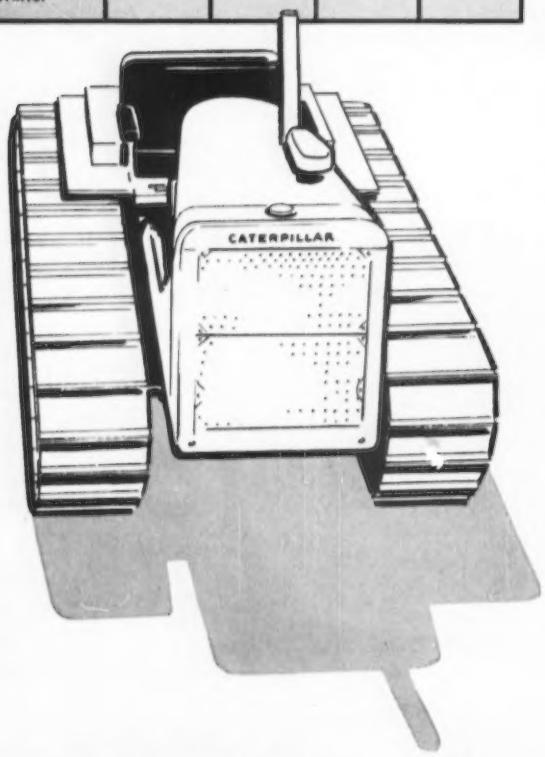
Compare engine horsepower... but as a source, not a "force"...

Adequate power is as important in today's pit operations as it was yesterday. It must be measured today, however, not only by its ability to "bull" a load, but by its ability to move the largest possible loads at the highest possible speeds, in the varied and scattered jobs assigned to present-day pit tractors.

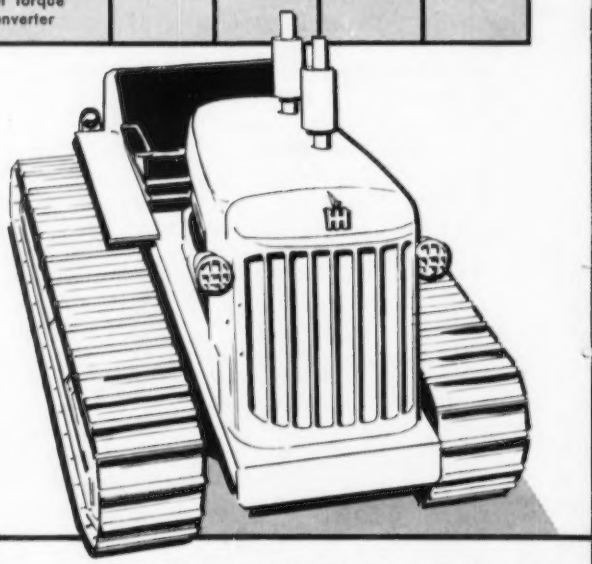
Maximum horsepower ratings alone are without meaning. Ratings must be studied across the speed range to measure your power dimension. Measure also the time and effort required for the operator to change his ratio of power application to push-pull effort or to speed effort. Check the smoothness with which power is applied, the waste in "bucking" a load. Also, the difficulties in shifting which may discourage an operator from using gear ratios to apply his power effectively.

Power at maximum "drawbar" is used little for tractive effort since, in low gear, tracks spin and power is wasted. Availability of maximum horsepower is important only in higher gears where it can be used with no slippage. *All* tractors are able to spin their tracks or wheels in low gear on normal footing . . . therefore horsepower should be considered as a power source available for use in *any direction* . . . should not be related to tractive effort alone. The most effective power combination lets the operator work at the highest practical speeds which job conditions permit.

CAT D8 191 hp with torque converter	MPH (Approx.)			
	1.5	2.0	2.5	3.0
	Pounds of pulling effort			
	30,000	24,000	18,000	15,000



IH TD24 200 hp with torque converter	MPH (Approx.)			
	1.5	2.0	2.5	3.0
	Pounds of pulling effort			
	32,500	22,500	18,000	15,000



Figures taken from manufacturers' specification sheets available to us at time of printing.

Usable pounds-pull results from many factors: type of material, conditions underfoot, weight of tractor, and forward speed, all combined have a definite effect on the pounds of drawbar pull.

From the charts, you can see that Tournatractor compares favorably with track-type tractors at today's commonly used speeds. When job conditions are adverse, use a crawler; in ordinary and favorable conditions you can put your job into high gear with rubber-

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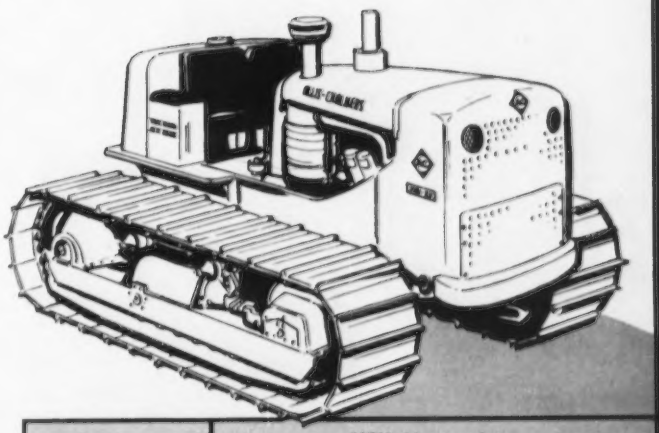
Dimension 2

TRACTION

Compare pounds pull...
but at your operating speeds...

The materials you handle partially determine your choice of tractors. Track-type tractors conquer the most adverse conditions and offer tremendous traction and drawbar pull in ordinary footing. However, today's broad, deep-treaded, tapered-bead rubber tires equal track-type traction in many materials. Where traction in loose materials is a factor, the rubber-tired tractor can be given additional traction by increasing its weight. Extra weight is easily obtained with hydroflation of tires.

This flexibility of weight will pay off in providing a tractor that can utilize its speed to the fullest extent — yet add tractive effort when needed to do a wider range of heavy-duty tractor work.

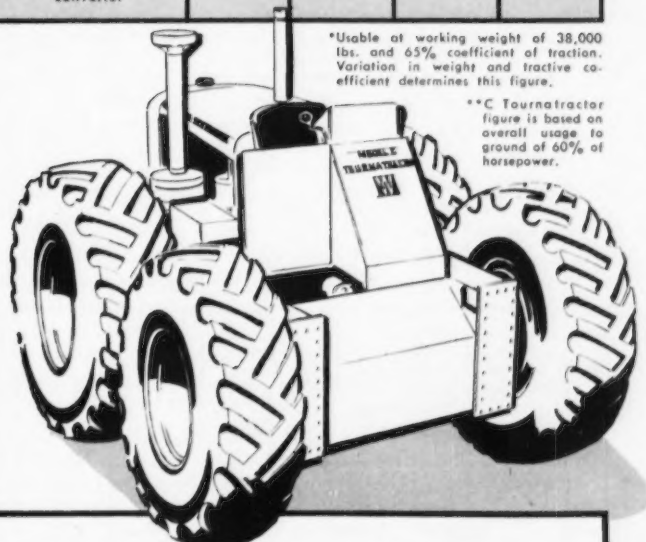


LeT-WEST C** 210 hp with torque converter	MPH (Approx.)			
	1.5	2.0	2.5	3.0
	Pounds of pulling effort			
	24,700*	23,500	18,800	15,650

AC HD21 204 hp with torque converter	MPH (Approx.)			
	1.5	2.0	2.5	3.0
	Pounds of pulling effort			
	Pounds-pull curve not shown in manufacturers' literature available to us.			

*Usable at working weight of 38,000 lbs. and 65% coefficient of traction. Variation in weight and tractive coefficient determines this figure.

**C Tournatractor figure is based on overall usage to ground of 60% of horsepower.



Comparable traction of tires to tracks, in some materials, is made possible by a wide choice of tire treads. A smooth-type tire, for example, works better than tracks in sand, because it doesn't dig in. Deep lateral cross-bars are designed for rock — the tire deflects over sharp rock and the deep tread prevents damage to the carcass. Diagonal bars give maximum bite in loose materials. Tournatractor tires — 2¼ feet wide, 5¾ feet high — are of double strength nylon cord and tough rubber. Inflated with only 20 pounds pressure, the tires flex over rough ground. Continual flexing of sidewall keeps the tread areas clean for a positive bite on each tire revolution.

Crawler tracks — long and wide — have shoes of steel with deep-biting grousers. At higher speeds, much of the engine output goes to power the tracks themselves. Much of the tracks' efficiency can be lost in gummy materials, since area between grousers fills in and tracks become smooth, flat belts. Accumulated mud and dirt on tracks and rollers also reduces theoretical power applied to pulling effort.

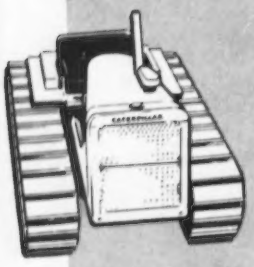
tired Tournatractor. Consider, too, how often you use all the traction available in track-type tractors. Ordinary dozing and push-loading are done in second and sometimes third gear, at speeds, ranging up to 2 miles per hour. High-speed dozing or loading with Tournatractor may require a thinner cut, but the excavated area is kept smooth, allowing faster travel of dozer and quicker entry and exit of scrapers. Too, it permits quicker return to work after wet weather.

before you buy, check all four dimensions . . . see next page

Dimension 3

SPEED

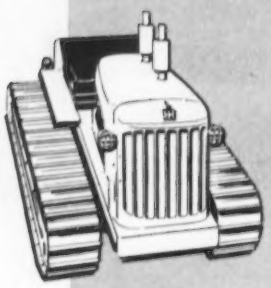
Compare speeds, and what they mean to profit...



CAT - D8

SPEEDS IN MPH

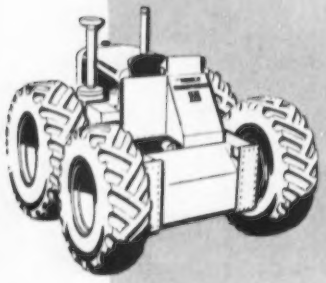
FORWARD	REVERSE
0 to 3.6 Low	0 to 3.6 Low
0 to 7.4 High	0 to 7.4 High



IH - TD24

SPEEDS IN MPH

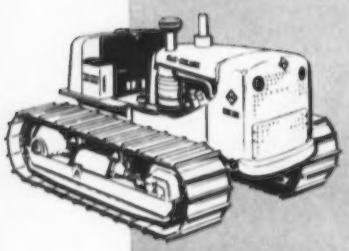
FORWARD	REVERSE
0 to 7.6	0 to 6.6



LeT-WEST C

SPEEDS IN MPH

FORWARD	REVERSE
0 to 17.2	0 to 7.2



AC - HD21

SPEEDS IN MPH

FORWARD	REVERSE
0 to 3.0 Low	0 to 5.5
0 to 7.5 High	

All above tractors equipped with torque converter. Figures taken from manufacturers' specification sheets available to us at time of printing.

Few heavy-duty tractors have kept pace with today's trend to high speed. Hauling units, loaders, shovels, scraper-combinations, and other types of pit equipment are now available on rubber for greater speed; yet most of the big tractors still roll on speed-limiting steel tracks. Habit, plus the large number of crawler-tractors still in use, make it easy to overlook the possibiilties of profit and time advantage available through use of the speed dimension. For instance, on an ordinary dozing cycle, if speed can cut your back-up time in half, you can increase the number of cycles per hour on this saving alone by 15%! Since costs remain constant, this increase in production is almost entirely profit! There is another point on speed that may be of interest. As crawler speeds are increased, and as the high gear-ranges are more extensively used, you add materially to the track-wear and overall maintenance expense.

The farther the travel distance, the more closely you should look into the advantages of rubber in the third dimension — *speed* — to increase your profits.

Work	Operation	Time (minutes)		
		Average Crawler	Rubber-Tired Tractor	Speed Saved in Min.
Dozing	Pushing load ..150 ft.	0.86	0.57	
	Return .....150 ft.	0.36	0.21	
	Gear changes	0.30	0.10	
	TOTAL	1.52	0.88	0.64
Pulling 15-yd. Scraper	Loading	0.75	1.25	
	Hauling .....1000 ft.	2.10	0.76	
	Spreading	0.40	0.40	
	Return .....1000 ft.	2.10	0.63	
	Gear changes	0.30	0.10	
	TOTAL	5.65	3.14	2.51
Push-loading	Loading	0.85	1.10	
	Return	0.42	0.21	
	Gear changes	0.30	0.10	
	TOTAL	1.57	1.41	0.16

Figures computed from manufacturers' specification sheets available to us at time of printing.

RESULT: With these minutes saved, you can doze more, haul more, do more clean-up . . . add extra profit with no extra cost.

before you buy, check all four dimensions . . . see next page

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Dimension 4

MOBILITY

Why rubber-tired mobility means more work per shift

Only a rubber-tired tractor can readily travel from job-to-job in your pit or plant operations. It can run at speeds to 17 mph, shuttle fast between shovel clean-up and other assignments. The operator just shifts into high gear and your tractor is on its way, via haul road or across the pit floor to its next job, whether to strip overburden, level stockpiles, tow other equipment, or switch railroad cars.

Larger pit areas, and higher production requirements, make it necessary to have equipment that can move around fast and easy on its own power.

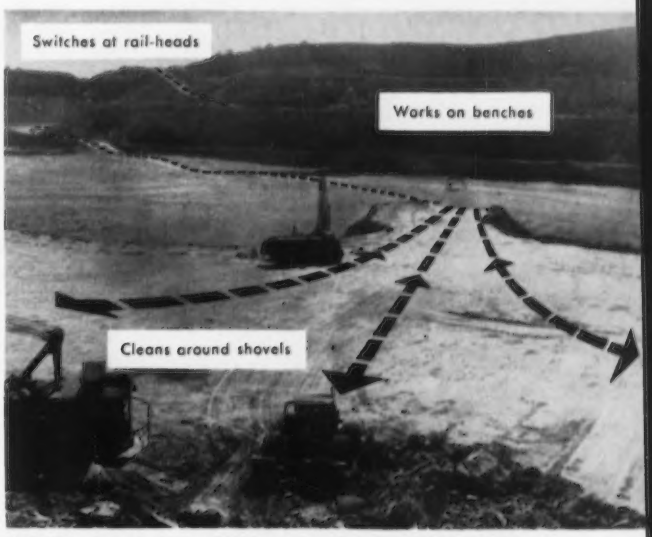
So the need for high-speed mobility is increasing each year, while the time and cost of moving track-type equipment designed for limited area work becomes higher and higher, cutting profits more and more.

In the light of these developments, it will pay you to consider the importance of *mobility* as a necessary tractor dimension in your pit operations.

Rubber-tired tractor travels at speeds up to 17 mph on work-and-run assignments. Operator can drive over pit floors, or off road. He can road his machine over tracks, ties, switches, and paving, without damage.

Tournatractor® is a modern tractor designed to take advantage of all four dimensions . . . *power, traction, speed* and *mobility*. It does not offer as much drawbar horsepower at speeds below 2 miles per hour as do track-type tractors of equal engine horsepower. But for pit operations where you *can* capitalize on the third and fourth dimensions — *speed* and *mobility* — with a machine that delivers comparable traction at present day speeds, we suggest you consider the *new* Tournatractor. The cost is 10% below that of track-type tractors with torque converters and comparable engine horsepower . . . and maintenance costs are lower.

There's a bonus-value for you in today's improved Tournatractor. A railroad coupler attachment is now available which converts this machine quickly to a practical SwitchTractor. With coupler at one end, and dozer at the other, this machine does double-duty . . . makes it an even more profitable tool for your pit operations. Your LeTourneau-Westinghouse Distributor will be happy to arrange a demonstration of a Tournatractor in your pit, to prove that its third and fourth dimensions — *speed* and *mobility* — can pay off for you. Ask him . . . or write the factory.



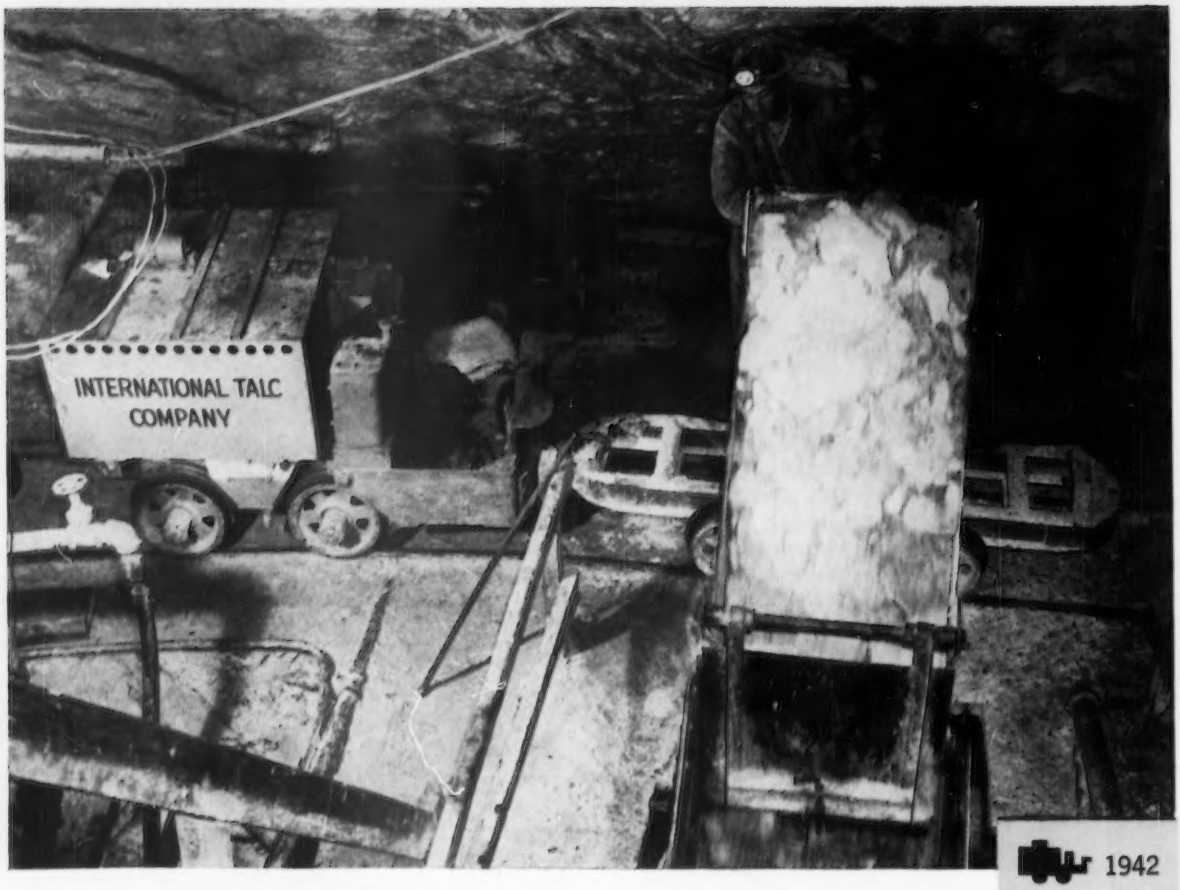
Sketched lines show range of rubber-tired tractor in typical mine. In foreground, tractor cleans-up around shovel. It ranges over entire pit floor for dozing, and on benches bordering the pit. Rail-head is only a few minutes drive away for switching work.

CT-1424-M

LET LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit



Mancha's Little Trammer...

How one good thing leads to another

In 1942, International Talc Company got its first Little Trammer to haul rock and ore. So well did this rugged 1½ ton powerhouse do its job that in '45 another Little Trammer was purchased; a third in '47 and a fourth in '49.

Then a merger of International Talc with another talc company revealed an almost identical experience with the Little Trammer. The second company had purchased one each year in '42, '44, '45, '48 and '51 . . . five in all.

So today International Talc has a fleet of nine Mancha's Little Trammers. And not only are they hauling ore and waste with ease and economy, but are also used for a variety of service work. They've paid for themselves over and over and are good for many more years of service.

1942
1942
1944
1945
1945
1947
1948
1949
1951

9

MANCHA STORAGE BATTERY LOCOMOTIVE
DIVISION GOODMAN MANUFACTURING COMPANY
Halsted Street and 48th Place • Chicago 9, Illinois • Cable Address: Mancha, Chicago
Mancha representatives are located in principal mining areas throughout the world.

100% anti-friction drive

gives you bonus push-power... top efficiency

Adams 660 grades sub-base on reconstruction of State Highway 140, near Foxboro, Mass. Contractor is Rufo Construction Co., Boston. John M. Rufo, Vice President, has this to say about the work-ability of his company's "660": "When slow, steady blading is needed, the Adams works slow without sacrifice of power. When fast secondary passes are made, no other machine can touch its speed. It definitely has greater pushing ability... practically eliminates the need for a bulldozer on a road graveling job."

Compared to other graders, Adams heavy-duty machines deliver a greater proportion of developed engine-power to tandem wheels. An Adams gives you this bonus work-power because all gears and shafts in transmission, final drive, and tandems turn on anti-friction bearings.

Push bigger loads . . . faster

Because the Adams' drive has roller- and ball-bearings throughout, very little of its horsepower is lost thru friction. More thrust is made available for pushing bigger loads . . . for blading deeper . . . for working faster. Furthermore, with an anti-friction drive, your graders' fuel-cost per unit of work done is correspondingly lower. Finally, longer bearing life cuts maintenance expense and downtime for repairs.

Transmission delivers maximum torque

The Adams transmission provides more power-speed combinations than other graders . . . 15 speeds . . . so you can do every grading operation at fastest practical rate. At each speed, transmission delivers maximum torque, because all gears and shafts turn on anti-friction bearings. It is fully constant-mesh . . . gears always engaged for fast, easy gear-shifts without clashing. Crown-shaved helical gears mate precisely . . . run continuously in oil . . . do not "howl" . . . give extra-long life.

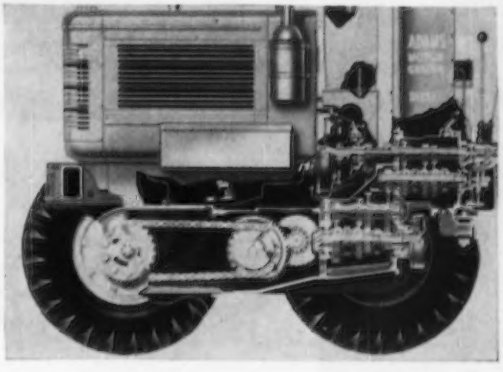
Rear-Axle carries no weight

In heavy-duty Adams graders, 80 to 190 hp, the main rear axles are full-floating — they do *not* carry weight of the grader. Instead, rear-end weight is borne by sturdy axle carriers, consisting of two concentric, tubular-shaped, steel housings — one inside the other. Tandems oscillate at will on the two axle carriers. Grader keeps all four tandem wheels on the ground, even in roughest terrain . . . driving, pushing, working all-the-time.

Inside the axle-carriers, driving-axles float "free", mounted in anti-friction bearings. They are fully protected from abnormal shocks and stresses of rough terrain . . . secure against breakage and undue wear.

All gears and shafts in the Adams transmission turn on ball-, needle-, roller-, and tapered-roller-bearings.

Main rear axles are mounted on anti-friction bearings, and carry no grader weight. Instead, rear-end weight is supported on concentric, tubular axle carriers. Inner axle carriers are bolted to tandems; outer carriers to final drive housing. Thus, tandems can oscillate freely — without putting stress on main axles. 100% anti-friction drive increases available work-power, reduces operating costs.



Ask for demonstration

See how Adams' 15* speeds, with power delivered thru 100% anti-friction drive, give these machines *bonus* push-power . . . a capacity for work no other grader can match. Let us explain how an Adams saves you money on fuel and repairs . . . how it can keep producing for you week-in and week-out. 6 models, 60 to 190 hp. Choice of General Motors or Cummins diesel engines on 5 larger models. Call or write for all the facts.

**190 hp* POWER-*Flow 660 provides infinite number of power-speed combinations (to 27.4 mph) thru torque converter. 60 hp Model 220 has 9 speeds forward, with optional creeper gears . . . best in its class.*

Adams, POWER-Flow—Trademark AG-1231-H-b

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT

Every Bite is a Payload

The effective use of power equipment is the very essence of successful mining operations. And everywhere that power is used in mines, you'll find Simplex-TIREX cords and cables on the job. These expertly engineered cords and cables, newly improved for greater flexibility, feature cured-in-lead Neoprene Armor that resists abrasion, oil, heat and water . . . gives longest life. **SIMPLEX WIRE & CABLE CO.,** 79 Sidney Street, Cambridge 39, Mass.

Wire sculpture by Henry Szafarz

Shovel Cable Type SH-D

LIVE BETTER ELECTRICALLY

Simplex

TIREX

See us at the Coal Show—Booth 1607

In cramped quarters like this, Tournapull Rear-Dump turns in dump position, which moves rear wheels forward for extremely short wheel-base. With bowl raised, 22-ton capacity C Tournapull, shown, turns 180° in only 20' 8" wide area, without backing.

Short 180° turns

boost pit output, cut handling costs

If you are interested in cutting cycle time on your pit hauls, consider Tournapull Rear-Dumps.

These high-production units are extremely maneuverable, can back into a shovel or restricted dump area faster than any haulers on the market. They make 180° turns by power steer thru geared king-pin in less than their own length. They eliminate time normally wasted maneuvering back and forth to turn in narrow quarters. They also frequently eliminate expense involved in construction of skid-plates or special turn-around areas.

Even where space is unlimited, rig's 90° prime-mover-turn gives you faster cycles. At the shovel, fast-maneuvering Tournapull Rear-Dump swings in and positions in 1 quick move. Loading unit need not sit idle while hauler operator wastes time on a wide sweeping turn, and a long, slow back-in. Quick, safe spotting saves additional production time at grizzly or dump.

Simplicity reduces maintenance

A great deal of your usual maintenance expense is also eliminated because of the simplicity of Tournapull's turn mechanism. Steering involves only an electric motor, connected to a rugged ring gear king-pin shaft. A flick of operator's finger activates motor . . . causes prime-mover to pivot up to 90° around trailing unit. Turns are made quickly, regardless of footing. There are no front steering knuckles, no reach rods, no complicated mechanisms to get out of line, maintain, or repair.

Check these, and all the other advantages of Tournapull Rear-Dumps. See for yourself how they speed haul cycles and cut costs. Write or call, any time, for owner-verified production studies and specifications. There's no obligation.

Model	Capacity	HP	Overall Length	Width req'd. for 180° turn	
				Travel position	Dump position
D	11 tons	138	24'10"	24'8"	18'8"
C	22 tons	208	29'9"	28'8"	20'8"
B	35 tons	293	35'10"	35'	27'

These features, too, cut your hauling costs

Hauls anywhere—Travels safely over narrow haul roads, paved highways, city streets . . . hauls cross-country over terrain, thru muck, rock, and soft fill.

Dumps fast, clean — Electric motor lifts body quickly to any desired dump angle . . . bowl tips behind rear wheels for clean over-bank spill. Streamlined body sheds material readily.

Cuts weather delays — Power-transfer differential applies extra power to wheel on firmest footing . . . pulls rig through mud, sand, soft materials.

Rugged body loads easily — Big bowl opening is easy loading target. Three layer, *all-steel* bowl with tool-steel floor resists wear and shock. Available with optional tailgate.

Improves safety — More than 4 times the braking surface of ordinary haulers plus optional electrotarder, low center of gravity, excellent visibility, front-wheel drive, easy control, all contribute to maximum safety.

Reduces fatigue — Big tires and air-foam cushioned seat smooth out ride for operator. Electric power steer and 2-way power dump make work easy.

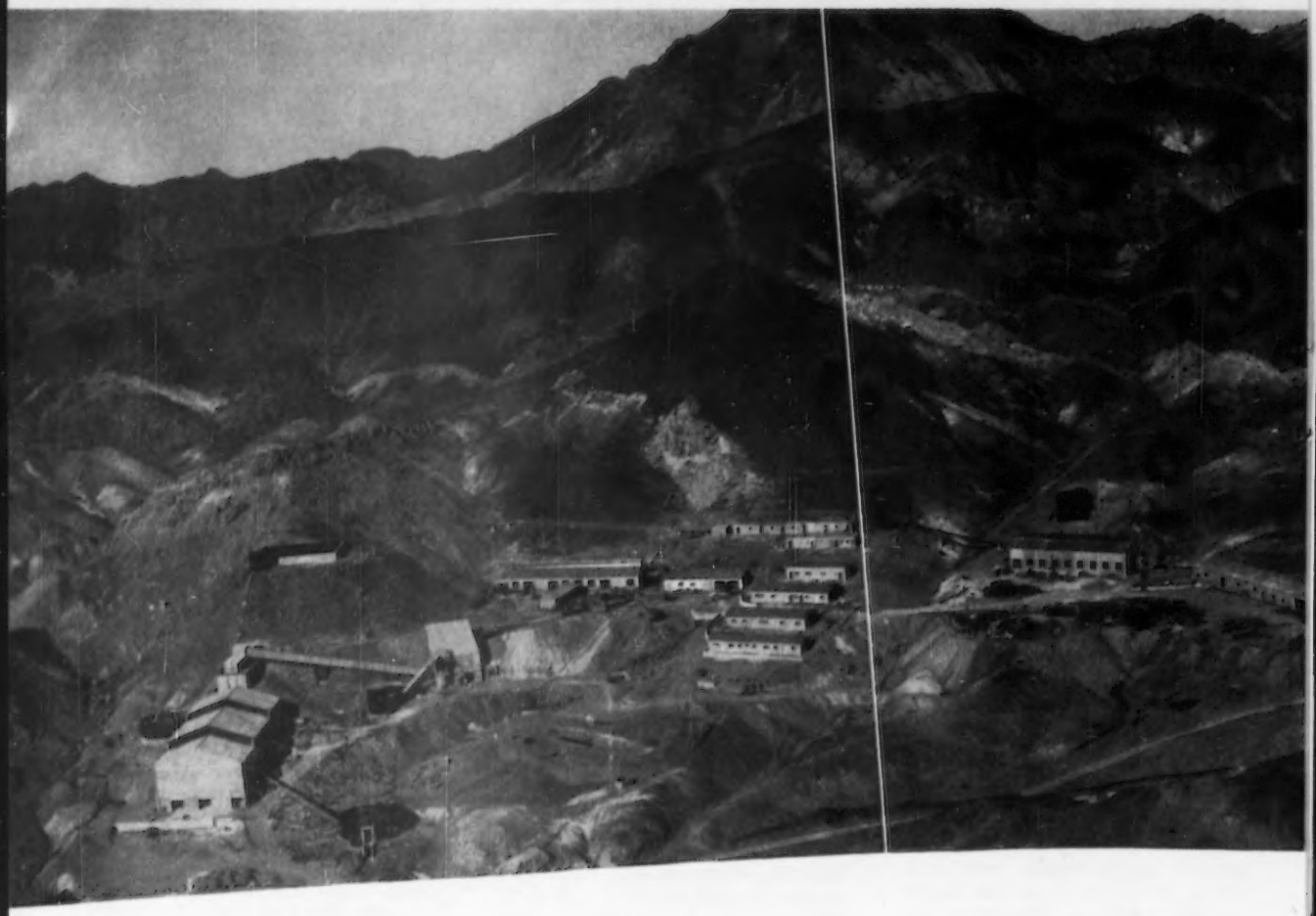
Insures future earnings — Behind basic prime-mover you can interchange other trail units: scraper, bottom-dump, lift-and-carry crane, logging-arch, flat-bed hauler. Keeps your Tournapull busy at a profit all year-around.

Tournapull—Trademark Reg. U.S. Pat. Off. R-1168-M-b

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit



Concentrating on the Andes

Isolation, unskilled labor, 7,000-mile supply lines, were some of the many headaches engineers faced in the construction of National Lead's ore concentrating plant in Argentina.

National Lead Company's Castaño Viejo mine, perched on the bare spine of the Argentine Andes, was 1,000 miles by truck and train from the smelter at Puerto Villelas. Transporting waste material costs time and money. Was it feasible to concentrate the ore at the mine site?

What was needed

Project and problems were set squarely before Southwestern Engineering Company engineers. What was needed: design, procurement and construction supervision of a complete lead, zinc and copper concentrating plant of 250 metric tons per day capacity; including crushing and screening plants and differential flotation plant, materials handling equipment, electrical and mechanical facilities, pump installation and diesel power plant.

Nightmare problems

What were the problems? Isolation: 1,000 miles from Buenos Aires, Argentina's main port of entry. Logistics: mine machinery would have to be shipped half way around the globe to Buenos Aires, then by

National Lead's Castaño Viejo mine, high on the Argentine Andes. Components and materials to construct an ore concentrating plant at the mine site had to be shipped half way around the world to Buenos Aires, then hauled by rail and truck 1,000 miles. SWECO engineers had the plant built and operating in 18 months. This photo was taken during construction.

train and truck to the mine site. And, the available labor supply was meager and unskilled.

Could SWECO have a plant operating at capacity 18 months after construction was started? SWECO's answer came in a proposal. It could be done.

Sweco team rolls up its sleeves

Engineers started the designs at SWECO's Los Angeles headquarters and SWECO purchasing, expediting and engineering personnel went to work on the project for National Lead Company, S.A. John Donoghue, veteran SWECO mining and construction engineer, was assigned as resident engineer.

With Donoghue as the pivot in Buenos Aires, the project rolled forward. Components and parts poured in from suppliers in California, Pennsylvania, New York, Colorado, Utah, Wisconsin, Iowa and England.

Then, in June, 1955, a nationwide revolution broke out in Argentina. Buenos Aires became a battleground. Donoghue was within running distance of the first bombings. He stayed through the second out break in September until, his work in Buenos Aires finished, he moved out to Castaño Viejo for the final phase of his assignment.

On the button

In June, 1956, just 18 months after construction began, the concentrating plant was complete and put into operation . . . on schedule.

It was a typical SWECO job. Done right, and done right on time, regardless of place or problems.

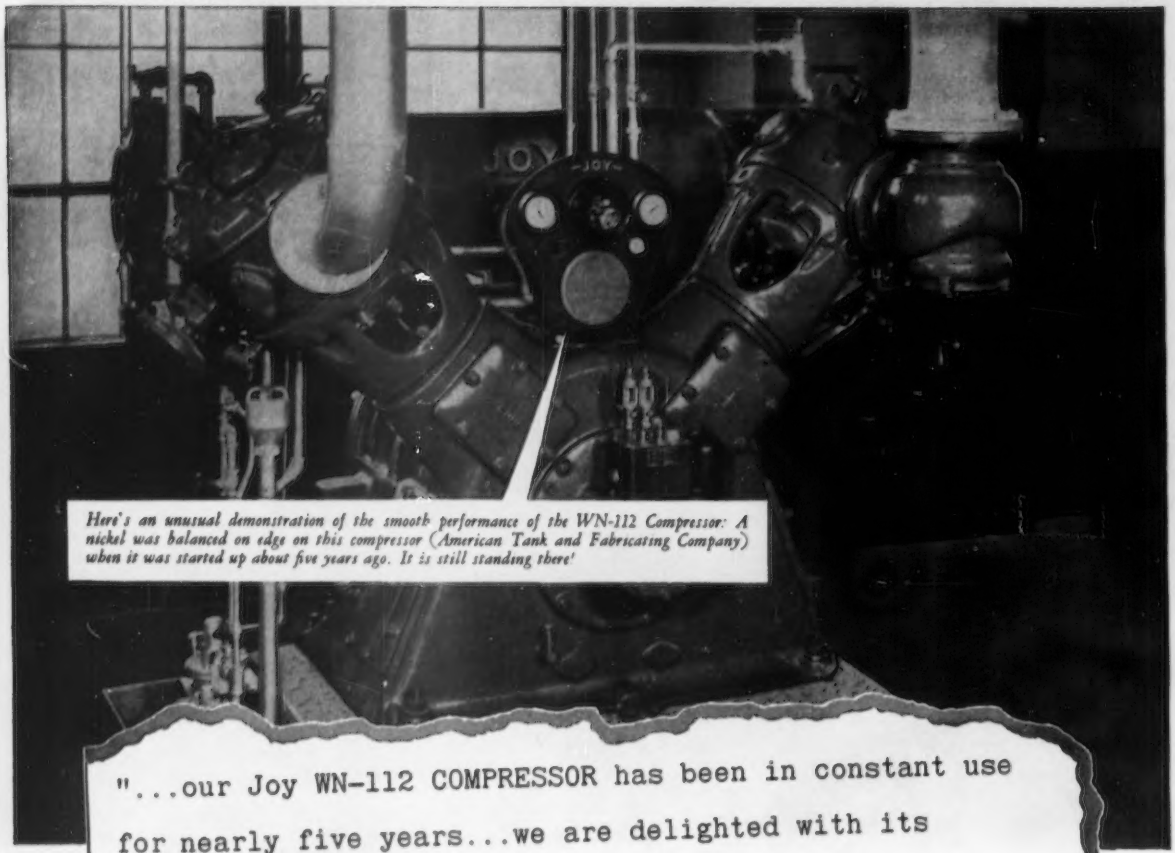
Typical also of SWECO teamwork on all jobs, whether in *engineering and construction* of ore beneficiating mills, heavy-media-separation plants, refineries and chemical plants . . . in the design and manufacture of *process equipment* . . . and in a complete line of *vibrating screen separators.*

Write today for our new brochure on how SWECO products and services can help meet your processing needs. Ask for brochure E-1-12.

SWECO

Southwestern Engineering Company

4800 Santa Fe Ave., Los Angeles 58, Calif.



Here's an unusual demonstration of the smooth performance of the WN-112 Compressor: A nickel was balanced on edge on this compressor (American Tank and Fabricating Company) when it was started up about five years ago. It is still standing there!

"...our Joy WN-112 COMPRESSOR has been in constant use for nearly five years...we are delighted with its vibrationless performance."

George F. Franck, Vice President
American Tank & Fabricating Company,
Cleveland, Ohio

There's no better story than a satisfied customer—

Nearly five years of absolutely *trouble-free* service is a performance of merit for any continuous-operation machinery. As a matter of fact, though, many of the original Joy WN-112 Compressors, built *two decades ago,* are still giving dependable service to satisfied owners.

Joy pioneered the use of high-rotation speed in heavy-duty compressors . . . were the first to bring to industry the many advantages of this new concept. The V-vertical design with flange-mounted motor resulted in a *compact*, heavy-duty continuous-service compressor that minimized vibration and paid off in trouble-free air power for industrial plants everywhere.

For more information, write **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Co. (Canada) Limited, Galt, Ontario.*

Write for
FREE Bulletin 142-4

A complete 28 page description of the WN-112 Compressor . . . section drawings, specifications and other useful information on heavy-duty compressor design and selection.

Consult a Joy Engineer

For Air and Gas Compressors, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors

WSW 1 6413-142

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

HD-21 crawler tractor, 204 net engine hp
315 scraper, 20 yd heaped, 15 struck

YOU CAN STRIP OVERBURDEN AND RECLAIM LAND PROFITABLY

with this crawler tractor-scraper team

There is a marked trend toward reclaiming worked-out pits—and a parallel trend toward the use of Allis-Chalmers crawler tractors and scrapers. Both are examples of wise management.

Land Reclamation—already a law in many states—eliminates to a large extent the scarred and worthless landscapes left by abandoned pits and piles of overburden. Properly reclaimed land usually returns far more than the cost of reclamation in higher resale value. Even where pits can be only partially filled, the land may be seeded profitably for pasture.

Allis-Chalmers HD-21 Crawler Tractor and 315 Scraper are ideal for this type of operation. This team is mobile and flexible enough to strip overburden and spread it immediately in a worked-out area of the pit. This eliminates the need of re-handling overburden and of calling in specialized equipment.

Curved and offset cutting edge on the scraper, plus torque converter drive on the tractor, are just two of many features that put this Allis-Chalmers team in a class by itself for this type of work. Let your Allis Chalmers construction machinery dealer give you the details. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

MAX-WEAR ALLOY

makes parts like these last longer

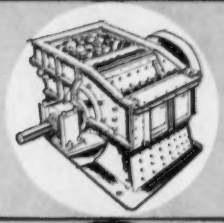
DREDGE BUCKET

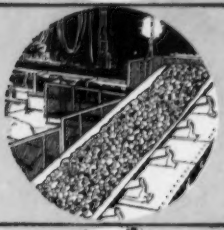
ROCK CRUSHER

CHUTE LINING

WEAR PLATE

GROUSER BARS





—keeps equipment on the job

Max-Wear Alloy Steel (13% manganese, 2% nickel) is *work hardening!* This means the more it's used the harder the surface becomes (up to 500/550 BHN). But only the surface hardens; the interior of the steel is unaffected. As a result, Max-Wear parts have truly wear-resistant surfaces *plus* high strength and toughness internally.

When you make parts like those shown with Crucible Max-Wear, you reduce downtime, cut repair and replacement costs. For Max-Wear resists repeated heavy impacts and abrasion—just what you need on jobs where equipment takes a bad beating.

Crucible Max-Wear is especially practical for repairs in the field. It can be formed cold or at *red heat*, and is easily shear or torch cut and welded. No annealing is necessary after these operations—a big advantage in the field.

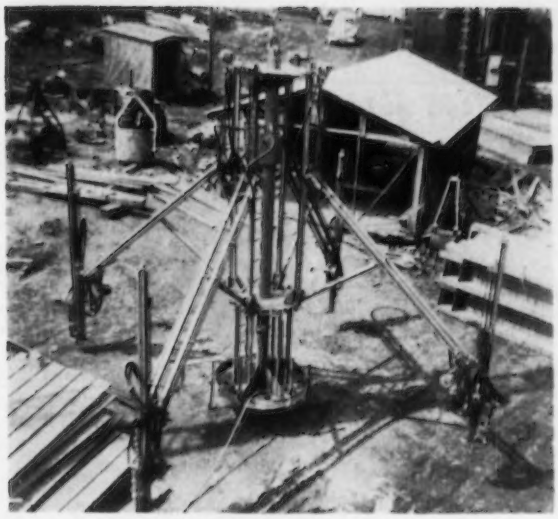
Max-Wear is now available in rounds, squares, plates and special grouser shapes. If you are looking for an easy-to-use alloy steel that will give you longer service under impact, wear and abrasion, try Crucible Max-Wear. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

E&MJ NEW PRODUCTS DIGEST

James W. Franklin

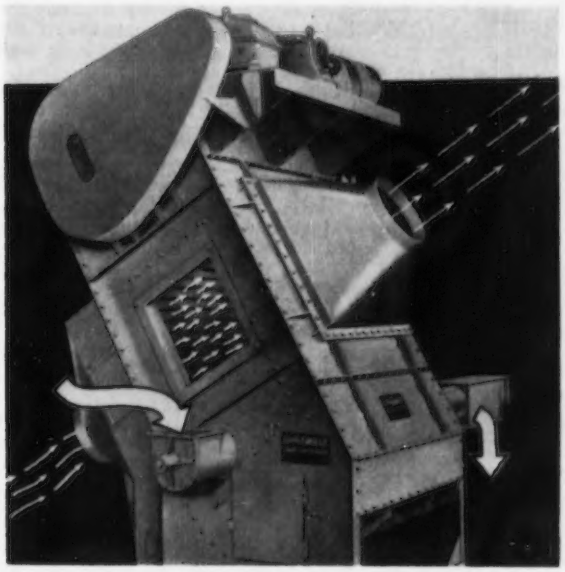


Rig Sinks 4- to 26-Ft Diameter Shafts (1)

With arms extended, Le Roi Div., Westinghouse Air Brake Co.'s SDR sinker has maximum drilling diameter of 26 ft on four drills. Sinker closes to 11 ft, but drills can be toed-in to drill pedestal which is 4 ft dia. Sinker can be equipped with 2⅝-, 3⅛-, 3½- and 4-in. drills. Drills and booms are air-motor controlled.

Power Rail Puncher (2)

Velocity-Punch Tool Co.'s punch uses a blank cartridge, instantaneously punches clean smooth holes for track bolts and rail bonds without electricity, compressed air or hydraulic power. Holes are burr-free and require no reaming. Two models are available: R-60 for maximum ⅞-in. holes on up to 70 lb rail; and R-100 for maximum 1½-in. holes on 110 lb rail.



Multi-Louvre Dryer (3)

Basically the Multi-Louvre dryer consists of a housing through which air is forced at controlled temperatures. Screw paddle and moving louvre pans raise the material and permit it to flow downard gently as a fine curtain of feed through which the heated or cooled air, gas or steam can be drawn. Material makes several passes through the air stream. Large capacities are possible. It is being used on coal preparation work.

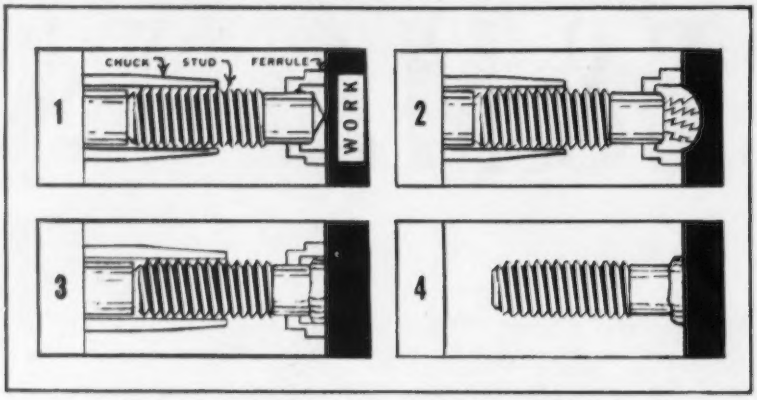
Kennedy-Van Saun Opens Research Center (4)

Studies and analyses ranging from single tests to long-range research will be made available to all companies, large and small, on an actual cost basis at Kennedy-Van Saun Manufacturing Co.'s new research station, Danville, Pa. Company has already established a pilot plant and an analytical laboratory is now being completed. President Fred O. Reedy states that "this will enable any firm to improve operations and develop new processes without having to invest heavily in establishing their own modern research tools and pilot plant." Equipment is available for crushing, grinding, ore dressing and chemical processing.

Continued on page 36. For more information on these items, use card opposite page 42.

Ground Electromagnetometer(5)

Ronka Ground Electromagnetometer can be carried easily by two men. Unit has horizontal instead of vertical loops. Powered by flashlight batteries, it can survey up to five miles of picket line in a day. It will be of most service in locating and detailing sulphide orebodies detected through airborne EM work, according to Ronka Geophysical.



Arc-Producing Welder Cuts Stud Placing Time (6)

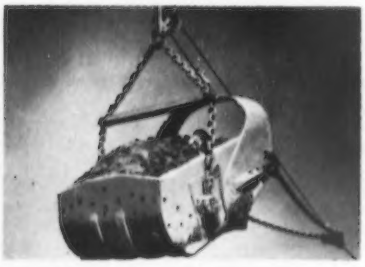
Nelson stud welding process is an extremely fast and dependable means of fastening to steel. No drilling, tapping, hand welding or through-bolting is required. Nelweld process is as follows: (1) welder presses welding end of the gun against the work plate until a ferrule (attached to the stud at the weld end of the gun) is flat against the plate; (2) pressing the gun trigger pulls the stud away from the plate and, (3) creates an arc, melting both the end of the stud and the plate at the spot; (4) now the stud is pushed into the molten pool on the plate and the weld is completed. Nelson Stud Welding Division, Gregory Industries, Inc., says that the process can weld many types of fasteners.

Optical Transit (8)

Many new design concepts are embodied in Wild Heerbrugg Instruments, Inc.'s Wild T-16, optical transit. Circles are read at a glance to one minute directly and to 20 seconds by interpolation. Built-in repeating clamp is used for setting on zero and eliminates lower plate motion.

Hydraulic Backhoe (10)

An efficient digging tool for trenching, ditching and digging jobs is this Hyster Hydraulic D4. Specifically designed for the Caterpillar D4 tractor, this ½-yd machine provides tractor-type mobility, according to Hyster Co.



Dragline Bucket (11)

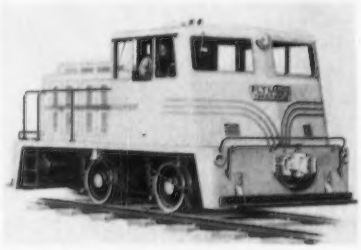
"A" Series line of Page Engineering Co.'s automatic dragline buckets have capacities from ½ to 3 cu yd. Buckets are light-weight, rugged construction and have the Page automatic digging feature. Series "A" buckets are available in light, medium, general purpose and heavy duty classes.

Hydraulic Ejection Trailer (12)

Hydraulically controlled ejector has ejecting force of up to 200,000 lb, will push out all or part of the load as desired. Model PE21 is powered by Caterpillar DW21 tractor and has 31-ton capacity, according to Athey Products.

Four-Wheel Drive Tractor (13)

Powered by 200-hp Cummins diesel engine with twin-disk torque converter, Wagner Tractor, Inc.'s four-wheel, all-wheel drive unit has 17-mph road speed and a reversible driver's seat.



Switching Locomotive (14)

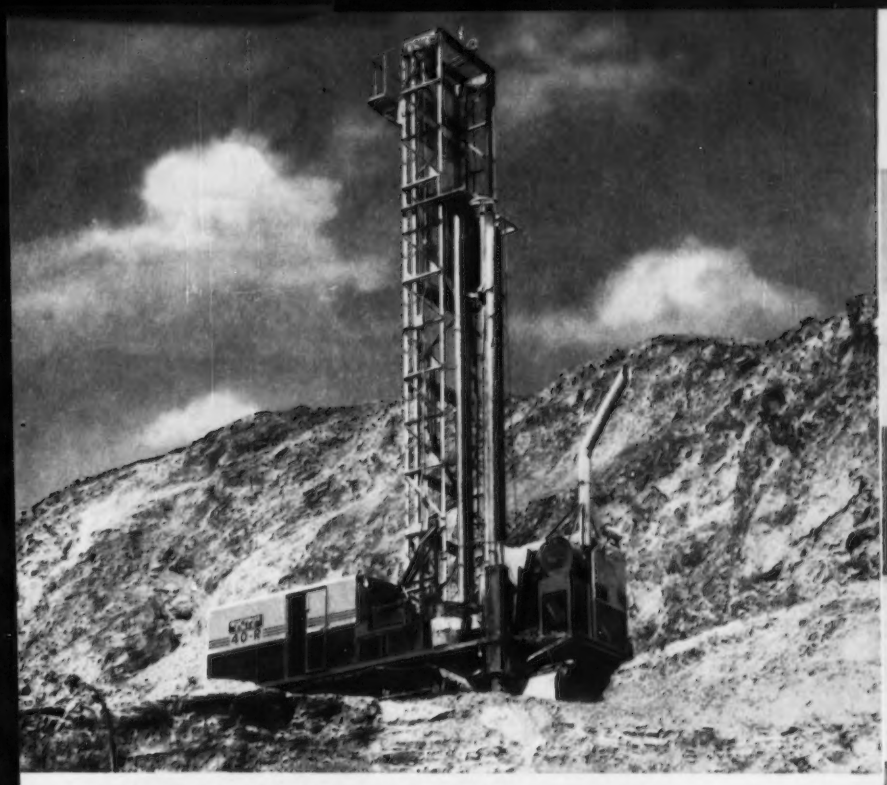
Following the trend of large railroad diesel locomotives, Plymouth Locomotive Works has developed a line of medium duty switching engines using the cab-in-front design. Locomotive is offered in 25- to 40-ton weight range with either 4- or 6-wheel drive.

Rotary Portable Drill (18)

Testborer developed by Pennsylvania Drilling Co. is designed to increase efficiency, economy and accuracy of subsurface exploration by combining into one compact portable drill the following features: augering to 150 ft; pipe-sampler driving to 150 ft; coring to 500 ft. Unit is trailer-mounted and has 6-ft hydraulic feed, 4-speed rotary unit, 4-speed hoist, 19-ft derrick and automatic driving mechanism.

Heavy-Duty Clothing (17)

Neoprene tunnel suit developed by Standard Oiled Clothing Co. is specially treated to withstand severe abrasion and resist snags and tears. Suitable for almost any industrial or construction job, the clothing is resistant to oils, grease, tars and most acids.



This Bucyrus-Erie 40-R is helping to raise production standards at a large open pit copper mine in western U.S.

This Bucyrus-Erie 40-R drills 9-in. holes through leached granite and a pyrite orebody containing copper.

Drilling 9-in. holes at an open pit copper mine, this Bucyrus-Erie 40-R puts down 5 times as much footage as cable tool drills previously used.

Bucyrus-Erie Rotaries Win Strong Approval in the Pits

"Enormously pleased. The 40-R surprised everybody favorably."—Copper mine operator.

"The 50-R drills do as much in one hour as a cable tool drill does in a shift."—Machine operator at a large open pit mine.

"The 40-R solved what seemed an unsolvable drilling problem by producing the necessary speed to stay ahead of the 150-B shovel."—Assistant manager of a large copper mine in western U.S.

These and similar comments are typical of the high regard owners and operators have for Bucyrus-Erie rotary blast hole drills. Since the first Bucyrus-Erie rotary was put into operation over four years ago, both the 40-R and 50-R have shattered old footage records in location after location.

There are good reasons for the popularity of Bucyrus-Erie rotaries. They offer *maximum controlled penetration* through hydraulically powered down pressure on the bit. They also provide *the most efficient drilling speed for a given formation* because of Ward Leonard electric control on rotation of the drill stem. *Hole may be drilled continuously* for the full length of a drill pipe—32 ft. 9 in. on the 50-R, 27 ft. 9 in. on the 40-R.

Bits are cooled by compressed air, and compressed air is used to remove cuttings: fine cuttings are picked up and handled by a Roto-Clone precipitator; heavies pile up adjacent to the drill hole for use as stemming material. *Manual effort is eliminated* for adding or removing drill pipe because of a remote-controlled power-driven drill pipe rack.

Let us tell you more about the speed and economy of Bucyrus-Erie rotary blast hole drills—the 40-R for drilling 6¾- to 9-in. holes, and the 50-R for drilling 9⅞- to 12¼-in. holes. Write today for detailed, illustrated literature. 53857C

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

A COMPLETE

A Size for Every Need...

in the only *Complete* Trailer Line

Athey-Cat PR21-DW21 maneuvers easily in tight quarters, handles big rock.

High-speed production on long hauls with the Athey-Cat PR15-DW15 Rear Dump.

Athey Hydraulic Ejection Trailer gives positive control in dumping and spreading loads.

ATHEY TRAILER FACTS . . .

Trailer-Tractor	Capacity
Athey PR21-Cat DW21	34-tons, 22.5 cu. yds.
Athey PR20-Cat DW20	34-tons, 22.5 cu. yds.
Athey PR15-Cat DW15	22-tons, 15.6 cu. yds.
Athey Hydraulic Ejection-Cat DW21 (or DW20)	31-tons, 22.5 cu. yds.
Athey PD20-Cat DW20	30-tons, 22 cu. yds.
Athey PH20-Cat DW20	45-tons, 62 cu. yds.

45-tons to 22-tons — rear dump, hydraulic ejection, side dump, bottom dump — matched trailers for Cat DW21, DW20 and DW15 Tractors — *only* Athey offers you this complete line of capacities and types of high-speed haul units.

Whether it's big rock, clay, ore, mud or earth you have to move, there's an Athey Trailer matched to your mining operations.

The most complete materials handling trailer line is built by Athey — the leader in the trailer field for more than 34 years. Each unit is built to the rigid standards of quality construction that mean longest life and low maintenance.

This is why Athey Trailers lead the field in big production, fast dumping, easier loading, more profits. Ask your Athey-Caterpillar Dealer for information on the complete line today. ATHEY PRODUCTS CORPORATION, 5631 West 65th Street, Chicago 38, Illinois.

THE *Complete* TRAILER LINE... *by the Leader*

Athey

Just off the press — describes complete Athey Trailer line. Write today.

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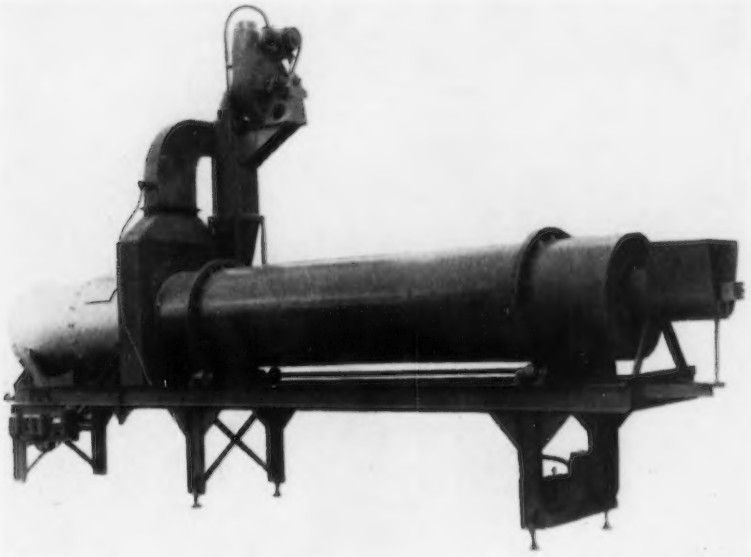


Dual-Flow Rotary Dryer For Granular Materials (41)

Compact and reliable dryer for efficient handling of granular material without loss of fines has been developed by Carpco Manufacturing, Inc. Carpco Dual-Flow features a concen ric fire-tube design which causes gases to travel the full length of the dryer before contacting the feed. Entire system is under slight negative pressure. Two models available.

Mechanical Pan and Portable Dredge Pump (42)

Small gold placers can be worked with Denver Equipment Co.'s Mechanical Gold Pan (weight—650 lb) and Portable Dredge Pumping unit. Mechanical Pan is operated from a 1½-hp gasoline engine. Dredge unit has engine, pump probe and hose. Probe will go to 15-ft depth. Mechanical Pan recovers gold by screening off the oversize, catching nuggets in a trap, fine gold on amalgam plate and heavy fines on matting. Pan duplicates hand panning methods.

Correction

New Products Digest, February *E&MJ* stated that Stoody Co. makes semi-automatic welders. This is incorrect. Stoody Co. makes and sells only the welding wire used in these welding machines.

Lithium-Base Grease (28)

Gulfcrown grease was designed for a wide variety of conditions such as: high and low temperatures, presence of water, high-speed bearings and long storage, according to Gulf Oil Corp.

GENERAL REFRACTORIES

A COMPLETE REFRACTORIES SERVICE . . . *for the Copper Industry*

Three types of basic brick—RITEX, GREFCO, STEELKLAD for the three basic processes—smelting, converting and refining. Each type of brick available in the ranges of composition—Magnesite, Magnesite-Chrome, Chrome-Magnesite and Chrome—required to adapt to variations in metallurgical processing.

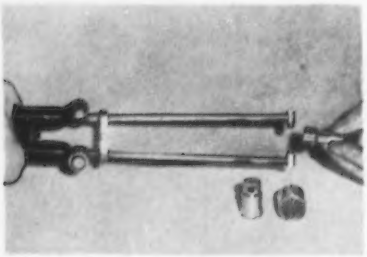
RITEX—chemically bonded for low cost, superior workmanship, resistance to spalling, ready availability.

GREFCO—conventional type bonded by tunnel kiln high temperature firing, for maximum strength and hardness.

STEELKLAD—steel encased on two, three or four sides and for special jobs, steel plates incorporated in the brick interior as well—for maximum resistance to spalling in the most severely treated exposed walls.

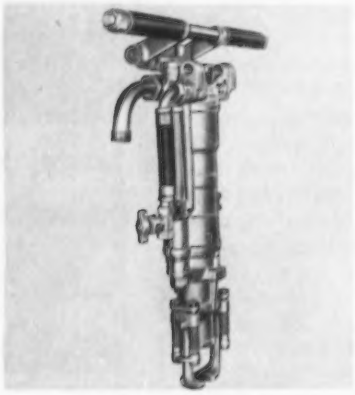
RITEX, GREFCO and STEELKLAD—each the result of many years of intimate knowledge of the copper industry and careful study of service conditions, each prepared from the best available raw materials and made with the most modern manufacturing facilities—all within easy access to your operation.

GENERAL REFRACTORIES CO.
Philadelphia 2, Pa.



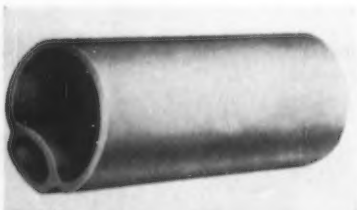
Gas-Oxy Hand Torch (20)

Bethlehem Apparatus Co. has developed a gas-oxygen hand torch with three interchangeable burner tips. Simply squeezing the handles drops the tip out so it can be replaced with desired tip. InstoChange will burn manufactured or natural gas.



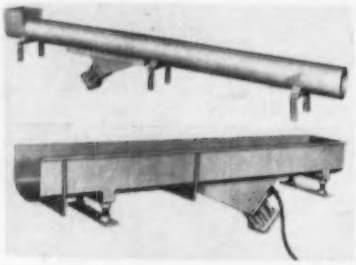
Shock-Absorbing Sinker (21)

Le Roi-Cleveland H-10, H-12 and H-111 sinker drills have been announced by Le Roi Div., Westinghouse Air Brake Co. with new handle that is designed to reduce operator fatigue and increase performance. Vibration is absorbed by rubber cushions in the handle that can be adjusted to control damping degree to suit the operator.



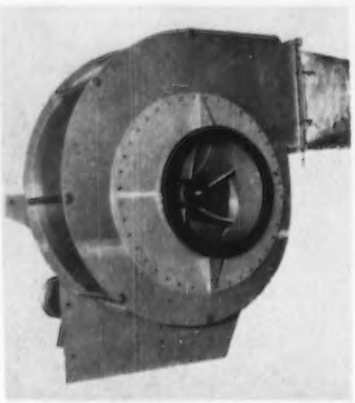
Steam-Traced Piping (25)

Aluminum Co. of America's Unitrace aluminum piping will lower costs and increase steam-tracing efficiency through the unique, two-in-one combination. Trace line and pipe line are formed in one operation and special shape has improved heat transfer efficiency over older forms of Unitrace, according to Alcoa.



Vibrating Feeder (27)

Instead of the usual electric vibrators or motors, the vibrating force on Cleveland Vibrator Co.'s newest feeder is generated by a pneumatic drive mechanism. Drive has only one moving part. Feeder will handle sand, gravel and fine feed and can move material uphill on slants as much as 20 deg. Vibrating frequency is varied by changing the air pressure over a 30- to 90-psi range. Feeder is available in pan, trough or tubular construction in a wide selection of lengths and feed rates.



Corrosion-Resistant Blower (29)

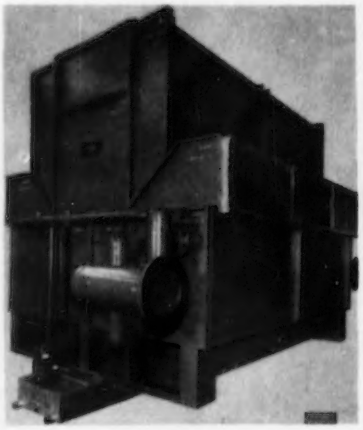
Industrial Plastic Fabricators, Inc. has added a 40-in. dia centrifugal blower, Model No. CB-40M, to their line of blowers that range in size from 143 to 15,000 cfm at various static pressures. Blower is made entirely of unplasticized polyvinyl chloride, in both the impeller and housing. PVC is resistant to most corrosive fumes and gases.

To Protect Belt Splices (32)

It is now possible to cover and protect conveyor belt splices made with Flexco Fasteners by using, REMA, a self-vulcanizing rubber repair material developed by Flexible Steel Lacing Co. Two treating methods are possible with this material. No heat is needed. No special skill required.

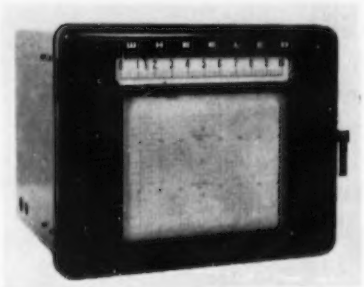
Pocket Radio Receiver (33)

Designed for in-the-building paging system to replace loud speakers, vest-pocket receiver has a built-in crystal loudspeaker that permits messages to be heard without putting the receiver to the ear. When carried vertically, the receiver is in operation. When laid flat, the unit disconnects its miniature battery. This radio needs a closed loop antenna circling the building, according to British Communications Corp., Ltd.



Compressor After-Cooler (38)

Unit offers a self-contained method of cooling and removing moisture from compressed air independent of a large supply of cooling water and replaces both shell and tube cooler, and cooling tower. Apparatus has two parallel cooling coils: one for compressed air and the other for the jacket water on the compressor. Four sizes of the Aero After Cooler are available with capacities up to 23,000 cfm of free air cooled from 275 to 85 deg F at 75 deg wet bulb atmospheric air, according to Niagara Blower Co.



Potentiometer Recorders (39)

Series 800 Multipoint Recorders are easy to read, operate and service, according to Barber-Coleman Co. Measurements can be made with thermocouples, radiation detectors and other devices where a measured variable can be resolved into electrical signals. Barber-Coleman's Wheelco Instruments Division says that the recorders are powered by 115v, 50/60 cycle. Stepdown transformer is available for 230v applications.

NORDBERG GRINDING MILLS

Their dependable service is your best recommendation

(Above): *Four Nordberg 10½'x16' Rod Mills and eight Nordberg 10½'x14' Ball Mills installed in a large concentrating plant for the reduction of hard, abrasive "Taconite" ore.*

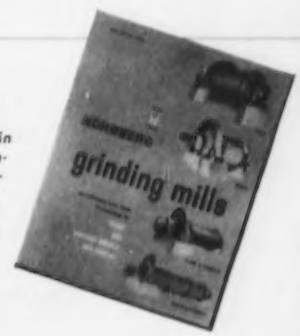
In the mining industry, thousands of service hours are required to prove true dependability . . . a significant reason why Nordberg Grinding Mills now are being selected for installation in many large ore reduction plants.

Nordberg Grinding Mills are designed and built for wet or dry grinding of metallic and non-metallic minerals. Sizes range from 6 to 13 feet diameter and up to 50 feet in length in Rod, Ball, Pebble, Tube and Compartment types.

Of advanced engineering and quality construction, Nordberg Grinding Mills assure trouble free and low cost operations. Consult an experienced Nordberg engineer next time you have a grinding problem. *NORDBERG MFG. CO., Milwaukee, Wisconsin.*

SEND FOR THIS NEW BULLETIN

This new Nordberg Bulletin 232 fully illustrates and describes the full line of Nordberg Grinding Mills for the efficient, low cost processing of ores and industrial minerals. Write for your copy today.



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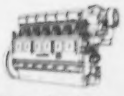

Diesel Engines

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GM157

THE CASE OF
THE IDEA THAT SAVED TWO DAYS
...I'M GOING TO LOSE ABOUT TWO DAYS WHILE WE REBUILD THAT FLYWHEEL CLUTCH!
WHY SHOULD YOU? PUT IN A REBUILT ASSEMBLY FROM OUR EXCHANGE STOCK AND YOU'LL HAVE YOUR TRACTOR GOING THIS AFTERNOON!
CAT
IS IT EXPENSIVE?
NOT AT ALL...
--YOU PAY ONLY FOR THE PARTS AND REPAIR SERVICE TO PUT YOUR CLUTCH IN THE SAME FIRST-CLASS SHAPE AS THE EXCHANGE UNIT. THEN YOUR REBUILT ASSEMBLY GOES INTO OUR EXCHANGE STOCK.
EXCELLENT IDEA! GO AHEAD...
THAT AFTERNOON
SURE AM GLAD I FOUND OUT ABOUT YOUR PARTS ASSEMBLY EXCHANGE PLAN, ART!
WE HAVE OTHER ASSEMBLIES ON HAND TOO, JIM. IT'S AN IDEA THAT REALLY SHORTENS DOWN TIME!
CATERPILLAR*
*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.
CAT CARE FOR LONGER WEAR
LET ME HELP KEEP YOUR CAT* EQUIPMENT ON THE JOB!
Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

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E&MJ NEW PRODUCTS DIGEST *(Continued)*

For More Details on New Product Items and For Copies of Free Literature Listed Below—Circle the Proper Number on Card. Be Sure to Give Your Name and Address

For Your Files

This selected manufacturers' literature is free unless otherwise specified. If item is for sale, send request and money direct to manufacturer.

HYDRAULIC BACKHOE Model D4 by Hyster Co. is latest in company line and is detailed in 6-page brochure now available from the company. (50)

INDUSTRIAL TRACTORS and equipment available from John Deere are all covered in 32-page color catalog. (51)

MOTOR SCRAPER design engineering, construction and operating features of Allis-Chalmers Manufacturing Co.'s TS-360, 20-cu yd motor scraper are set down in 16-page bulletin. (52)

CRAWLER TRACTOR TD24 by International Harvester Co. is described in 8-page, two-color mailer. TD24 has 200 hp and is largest of the seven models available. (53)

CONSTRUCTION CASE HISTORIES—drilling, blasting, bit types, bit life and excavating methods are covered in detail in American Cyanamid Co., Explosives Department's fine and thorough 4-page glossy bulletin. Release gives full details on 48 drilling and blasting projects, including formation, stratification, all equipment used, bit performance and blasting techniques. Also shows 12 blasting patterns. (54)

DO'S AND DONT'S FOR DIAMOND DRILLING is the title of Joy Manufacturing Co.'s helpful bulletin that supplies over 200 operating tips from care of bits to use of wrenches. One section covers bit recommendations for various geological formations. Very good. 12-pp. (55)

HOW TO SELECT AN AIR COMPRESSOR of the right size and type is the title of 12-page comprehensive booklet published by Air Compressor Research Council, 27 East Monroe, Chicago 3, Ill. Price is 50c. Address your request to the Council. This is not a free literature notice.

WASTE HEAT RECOVERY FROM AN AIR COMPRESSOR, a reprinted article from *Industrial Heating Engineer,* can be obtained upon request from Atlas Copco Eastern. Article is illustrated in 4 pp. (56)

HOW TO INSULATE A CABLE explains in 28 pp the four most-used methods employed by manufacturers for applying insulation to electrical conductors. Pocket-size. Available from Okonite Cable. (57)

ROPE DOPE, a series of bulletins published by Union Wire Rope Corp., is distributed at regular intervals by the company. Each bulletin is 4 pages and discusses such items as how to choose a rope, how to protect a rope and how long will it last. (58)

WIRE ROPE SLINGS in three designs—Uniflex, Multiflex and Maxiflex—are covered in separate folders available from Wickwire Spencer Steel Division of Colorado Fuel & Iron Corp. (59)

ARC WELDING ELECTRODE DATA BOOK prepared by National Cylinder Gas Co. is 24 pp, covers electrode specifications, how to estimate consumption and how to select proper electrode. (60)

AIRCOMATIC CUTTING method is covered in detail in Air Reduction's 2-page bulletin. (61)

CONTROLLED ARC POWER SUPPLY benefits are illustrated in Metal & Thermit's 4-page bulletin. (62)

ELECTRICAL HEATERS AND HEATING DEVICES available from General Electric Co. are cataloged in 72-pp. One 16-page section covers power requirements, gives long and short form calculations for heating applications. (63)

BETTER CONTROL electrically for heating and ventilating systems is the subject of 16-page booklet released by Barber-Colman Co. (64)

LIGHTING EQUIPMENT for commerce and industry manufactured by Benjamin Electric Manufacturing Co. is set down in thick, hard-backed, comprehensive catalog. (65)

TOTALLY ENCLOSED and fan-cooled motors are introduced in Robbins & Myers 4-page release. RM motors are available from ½- to 40-hp sizes. (66)

MAINTENANCE NEWS, Vol. XXI,

APRIL 1957

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2	16	30	44	58	72	86
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4	18	32	46	60	74	88
5	19	33	47	61	75	89
6	20	34	48	62	76	90
7	21	35	49	63	77	91
8	22	36	50	64	78	92
9	23	37	51	65	79	93
10	24	38	52	66	80	94
11	25	39	53	67	81	95
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14	28	42	56	70	84	98

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E&MJ NEW PRODUCTS DIGEST *(Continued)*

No. 1, as released by Westinghouse Electric Corp., contains articles on motor maintenance and care of dry-type transformers. *Maintenance News* is a regularly scheduled Westinghouse publication. (67)

PIPE INSULATION NEWS from Gilsonite Division, American Gilsonite Co. will be a quarterly publication dedicated to telling how to apply this easy-to-use, poured-in-place, natural insulating compound. (68)

GULF'S PETRO-ENGINEERING SERVICE, what it can do for you and how to obtain this help is the subject of 22-page booklet. Engineering service group can help you solve your fuel, heat, power, lubrication and maintenance problems. (69)

HOW THE KEYSTONE RT FITTING simplifies bearing lubrication is the text of 4-page bulletin being distributed by Keystone Lubricating Co. (70)

SPRAYABLE CEMENT-MORTAR COATING for corrosion-proofing steel pipe (both inside and out) is discussed in 4-page bulletin released by Chemical Fire & Rust Proofing Corp. (71)

MECHANICAL PACKING materials that can be had from Flexrock Co. are presented in 4-page bulletin now available. (72)

FLOAT VALVE technical data bulletin being distributed by Golden Anderson Valve Specialty Co. is 16 pp, shows design and function of this hot or cold water type float valve. (73)

TRANSISTOR MANUAL, announced by General Electric Co., includes basic information on semi-conductor theory, construction techniques, circuit design and specifications of all transistors registered with the Radio Electronics Television Manufacturers Association. Price is 50c. Address your request to General Electric Co., Semiconductor Products, Electronics Park, Syracuse, N. Y. This is not a free literature notice.

WORM GEAR SPEED REDUCER catalog prepared by Cleveland Worm & Gear Co. is hard-backed in 173 pp. Catalog covers in detail all applications and installations of their products. This master engineering reference is thoroughly illustrated with cuts and tables. (74)

CURRENT LIMITING REACTORS for circuits of 34,500v and under are detailed in General Electric Co.'s 16-page illustrated brochure on cast-in-concrete reactors. (75)

VIBROLATORS for industrial application in the Martin Engineering Co. line can be examined in their leatherette-bound 36-page catalog. Catalog describes in detail the action of the all-directional, high-speed vibrator used for moving granular matter. (76)

SCREW-CONVEYOR DRIVE catalog just released by American Pulley Co. describes the "Screw-King" drive that's designed exclusively for screw conveyors. 8 pp. (77)

ROLLER CHAIN book now being distributed by Link-Belt Co. contains complete presentation of the many features of LXS bushed roller chains. Design features, application and selection data are supplied in 15 pp. (78)

SCREW CONVEYOR components by Link-Belt Co. are described in 6-page bulletin. (79)

PORTABLE CONVEYORS in the Barber-Greene line are detailed in 4-page release. (80)

WOBBLER FEEDER, a revolutionary feeder, according to Universal Engineering Corp., can be examined through their 6-page data sheet. (81)

FOR SELECTIVE MINERAL ANALYSIS Stearns Magnetic Products Division, Indiana Steel Products Co. suggests that you consider Ring-Type-D magnetic separator as described in their 4-page mailer. (82)

INDUCED ROLL MAGNETIC SEPARATOR offered by Carpco Manufacturing, Inc. are described in 4-page release now available from the company. (83)

HIGH TENSION ELECTROSTATIC SEPARATORS from Carpco Manufacturing, Inc. are described in 4 page bulletin just released. (84)

AIRPHOTO ANALYSIS AND INTERPRETATION in engineering-geology investigations is the title of a reprinted article from *Engineering Digest*. It can be obtained through Hunting Aerosurveys Ltd. Illustrated in 11 pp. (85)

CONTINUOUS CARBON MONOXIDE ANALYZERS are accurate, dependable, versatile and automatic, according to Mine Safety Appliances Co.'s four-page bulletin. (86)

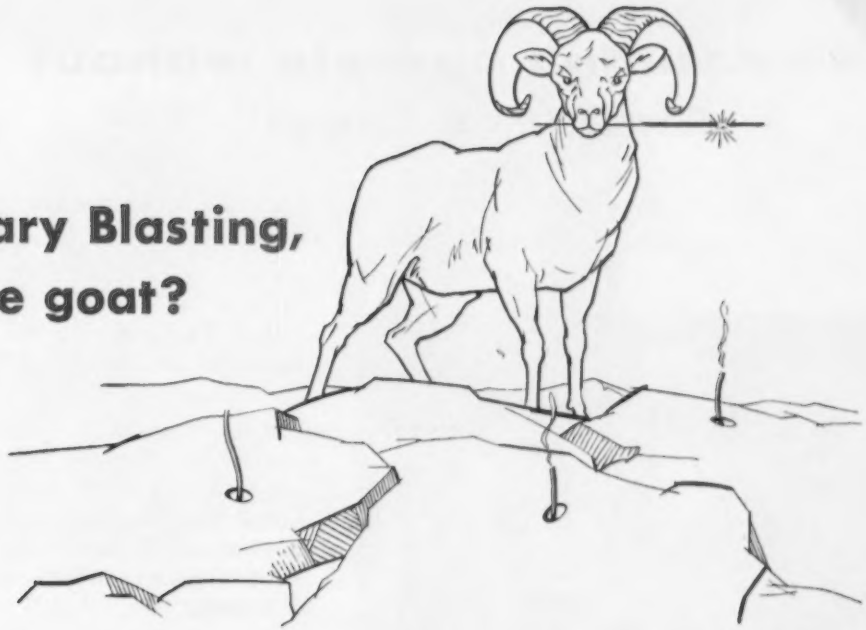
AUTOMATIC GEAR SPRAYING by Alemite Division, Stewart Warner Corp.'s method can be examined in their eight-page bulletin. (87)

POWER RATING CHART, for International engines and power units, gives all the details in 4 pp, according to International Harvester Co. (88)

AUTOMATIC DRAGLINE BUCKETS in the Page Engineering Co.'s "A" series are described in an eight-page release. (89)

REAR DUMP TRUCK, built for low yardage costs and minimum maintenance by Euclid Division, General Motors Corp., is detailed in eight-page bulletin. Other bulletins are also available on Euclid's 12-yd (struck) S-7; 26-yd (struck) R-40; and 23-yd (struck) S-18. (90)

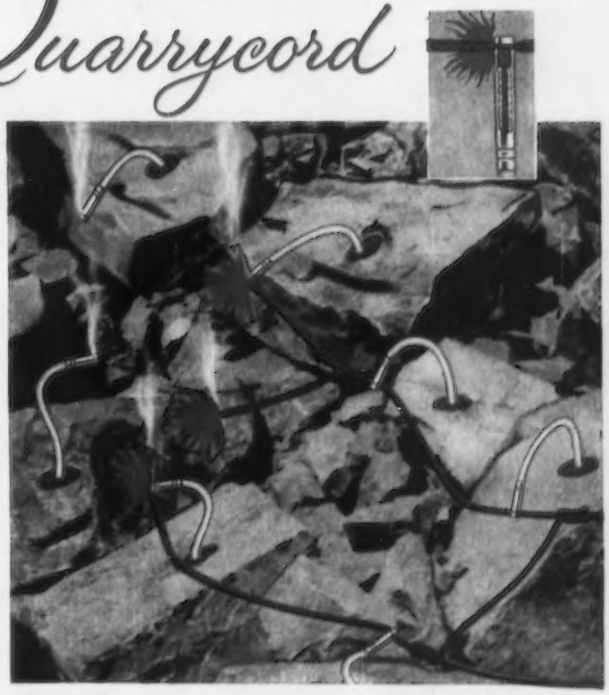
In Secondary Blasting, why be the goat?



. . . when you can play-it-safe with *Quarrycord*

You play-it-safe three ways when you use safety fuse and Quarrycord in your secondary blasting:

1. You can ignite each and every fuse *from one remote point* and eliminate the hazard of men climbing over the rock pile.
2. You gain the advantage of *fuse* blasting — "pop-pop-pop" instead of "boom!"
3. You fire when ready, without danger from stray electrical currents from equipment or thundershowers.



Quarrycord looks like colored twine. It is soft, pliable — easily lighted with a match and burns with an open flame at the rate of about one foot per second.

It's easy to use. Cut your safety fuse in equal lengths. On the end of the fuse opposite the cap place a Quarrycord Connector. This is a copper tube containing an ignition compound. The end is slotted to hold the Quarrycord securely.

After loading the holes, connect each fuse with Quarrycord, and make cross connections wherever a short cut will get the flame to the fuse in less time.

Run the end of the Quarrycord to a place where it can be lighted easily — light it with a match and go to a place of safety.

This folder tells the whole story: what Quarrycord is, how to use it and what it can mean to you in greater safety and lower costs in secondary blasting. We have a copy waiting for you — it's free.

For more information see your explosives supplier or write to

Q-1

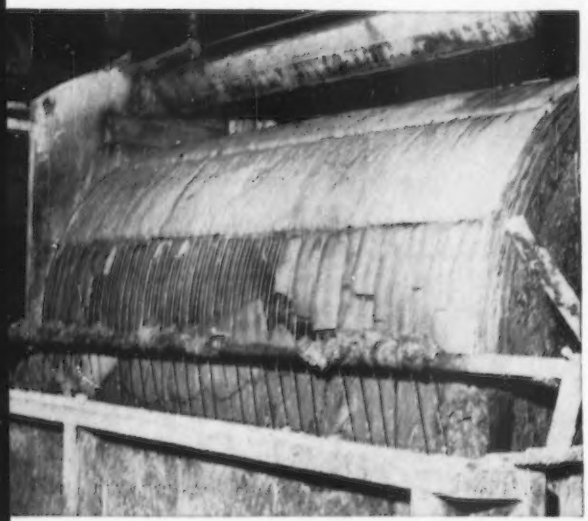
THE ENSIGN-BICKFORD COMPANY

Simsbury, Connecticut • Since 1836

Primacord® Detonating Fuse, Safety Fuse, Ignitacord®, Quarrycord, Pyrotechnical Devices and Blasting Accessories

"We couldn't operate without Stainless Steel"

SAYS J. S. MITCHELL, PLANT MANAGER
CALERA MINING COMPANY, GARFIELD, UTAH



Vacuum drum filters—made from Stainless Steel.

This is the nation's largest cobalt refinery. The plant, opened in 1952, has gained fame because of the unique process employed.

The refining process involves leaching with a solution of sulfuric acid. The plant operates 'round the clock, seven days a week. And *fifty percent* of the process equipment is made from Stainless Steel, Type 316. According to Plant Manager J. S. Mitchell, "At our acid concentrations, Stainless Steel holds up at temperatures as high as 200 degrees Fahrenheit."

Only Stainless Steel combines so many useful properties: corrosion resistance, surface smoothness, strength and weldability. Think of Stainless when you plan. Think of *USS* Stainless when you buy.

Stainless agitators maintain concentrates in suspension.

The pure cobalt. It's worth $2.60 a pound.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
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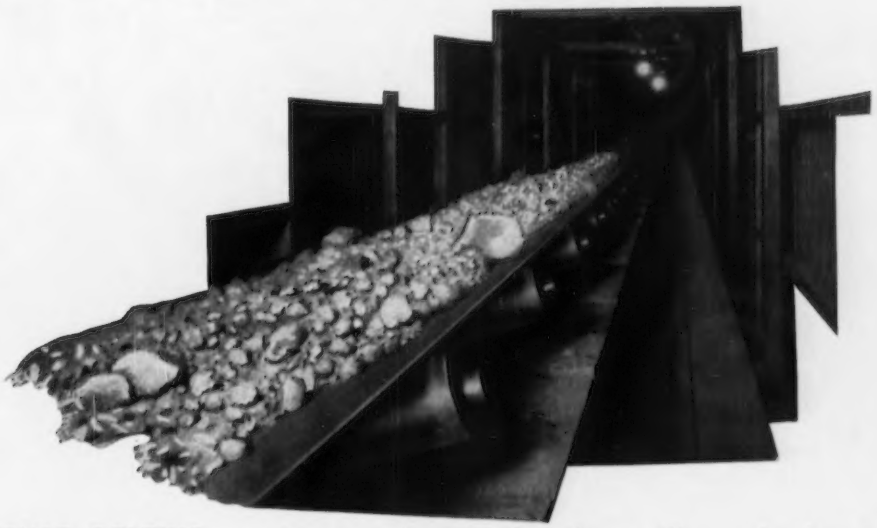
USS STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

6-2610

UNITED STATES STEEL

REVELATION AIR HOSE... for heavy-duty, high pressure service—extremely flexible... defies wear, abuse and abrasion.



CONVEYOR BELTING... whatever the job, Hamilton will supply the proper belt for your needs... and you'll get longer service life, too.

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Write today for more information and literature.

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MANUFACTURING CORPORATION • Trenton 3, N. J.

A Division of Acme-Hamilton Manufacturing Corporation

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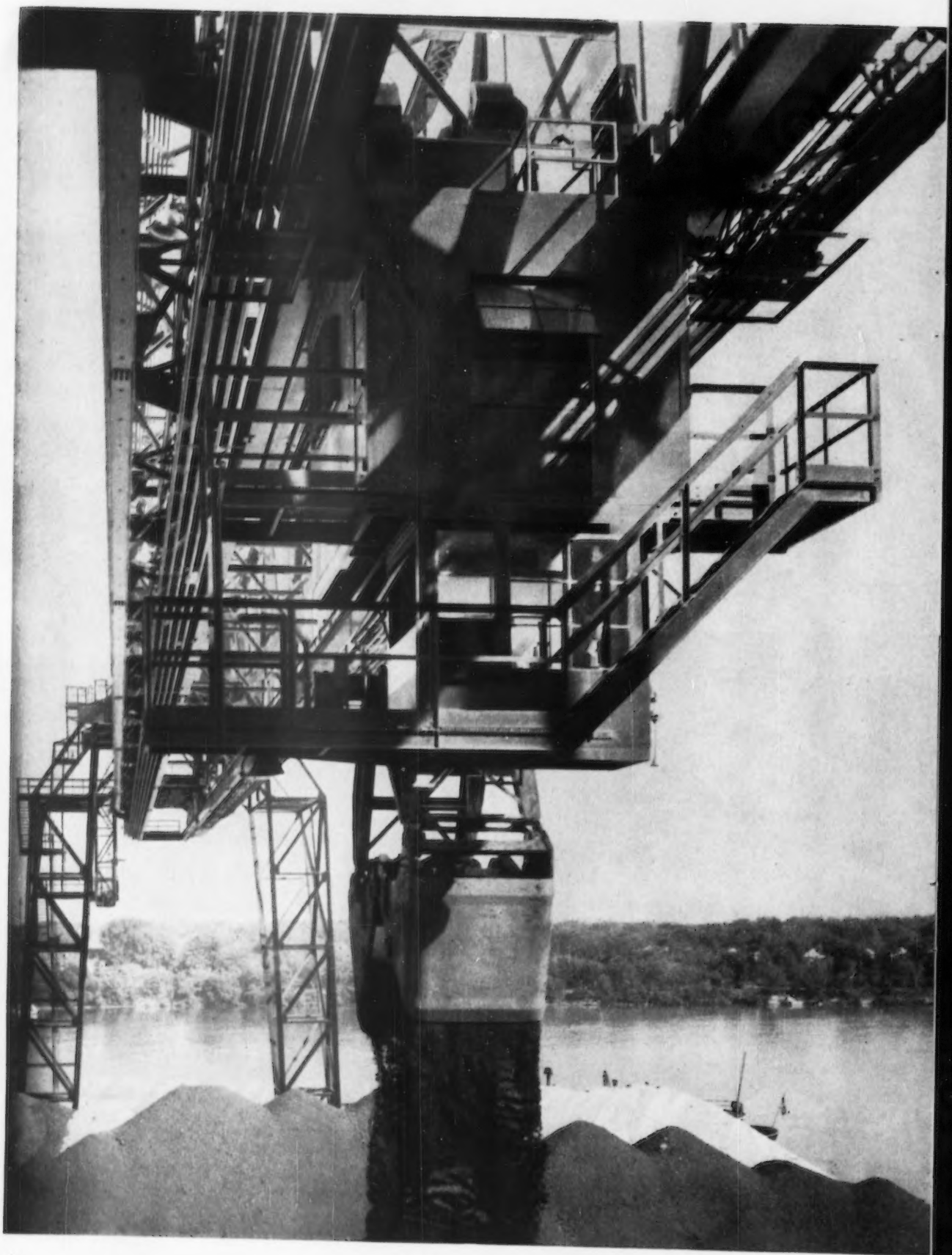


2,300,000 pounds ship-to-shore in one hour!

Westinghouse-equipped ore unloaders set new highs in speed and dependability for McLouth Steel

Power. Durability. Precision. These were the requirements for the motors and controls to operate these two 547-foot ore bridges for McLouth Steel. Westinghouse supplied the solution with rugged MC mill motors and the newest developments in automatic controls—Magamp* and Rototrol®.

In just 41 seconds, these ore bridges run a complete cycle—digging, hoisting, trolleying, dumping, rehoisting and back again for another 27,000-pound scoop.

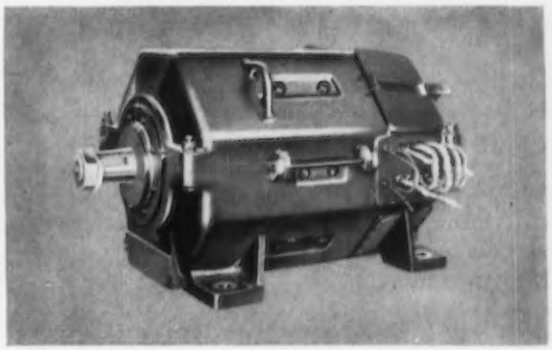
It will pay you to investigate the facts that give such outstanding results as these when you are considering motors, drives and controls. Get the details from your Westinghouse sales engineer. Or write Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pennsylvania.

*Trade-Mark
J-21957

YOU CAN BE SURE...IF IT'S

Westinghouse

These two new ore bridges can unload all size boats by means of an adjustable "apron" which can be raised high enough to allow the mast of any vessel to pass underneath. Dependable Westinghouse hold-and-close motors carry the load on this modern installation.



Rated at 187½ hp, 230 v, 460 rpm, this 616 Series mill motor gives the kind of outstanding performance to meet today's tougher, faster jobs. Westinghouse engineers are ready to work with you to give you the best motors and controls for your needs.

Bethlehem Hollow, in jackhammer equipped with feedleg, drills blast hole in Portland-Monson Slate Company mine, Monson, Me. *Drill steel supplier:* Bicknell Manufacturing Company, Rockland, Me.

Mining vertical slate bed in New England

Here Bethlehem Hollow Drill Steel is biting into slate in one of the 300-ft tunnels in the Portland-Monson Slate Company mine at Monson, Me. The product: slabs of slate, for use in electrical applications.

But drilling in the Monson mine isn't as easy as it may look. This is because the slate bed is vertical, making the side walls of the tunnel extremely hard. Yet the 1-in. Bethlehem Hollow, fitted with carbide-insert bits, has been providing excellent service in drilling blast holes 20 ft deep. Said the superintendent recently, "We've used Bethlehem Hollow here for the past eight years. It's satisfactory in every way."

Bethlehem Hollow makes possible low-cost-per-foot-of-hole drilling because it is rolled from steel which is specially selected for resistance to fatigue. Bethlehem Hollow has a uniform hole, centrally located in the bar. It has a wide quenching range, and is easy to heat-treat for the proper balance of toughness and wear-resistance, resulting in long-wearing threads and strong shanks.

Team up with Bethlehem Hollow Drill Steel for all your rock-drilling operation . It's obtainable in carbon and ultra-alloy grades, in rounds, hexagons and quarter-octagons, and in lengths ranging from 18 ft to 27 ft. For special requirements, longer lengths can also be furnished.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

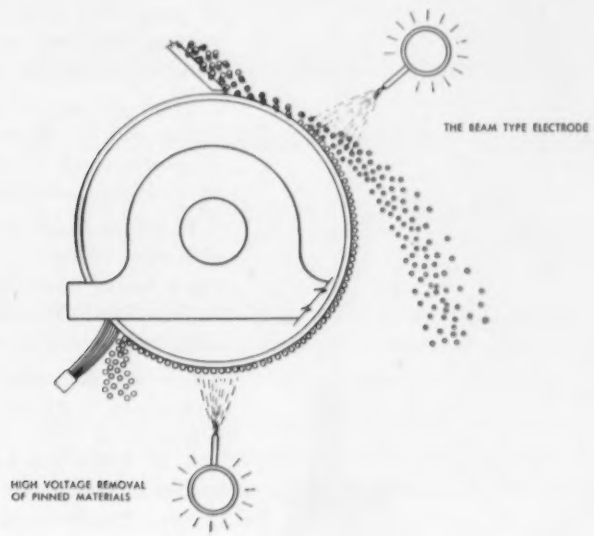
BETHLEHEM HOLLOW DRILL STEEL CARBON AND ULTRA-ALLOY

BETHLEHEM STEEL

By Far... Carpco

is the world's most progressive company in the field of high voltage separation and especially in the electrodynamic type called . . .

HIGH TENSION SEPARATION



Now industrial installations in over thirty countries have produced over a million tons of valuable minerals by use of Carpco high tension separators.

From the smallest detail to completely integrated plants — it's Carpco all over the world!

Carpco

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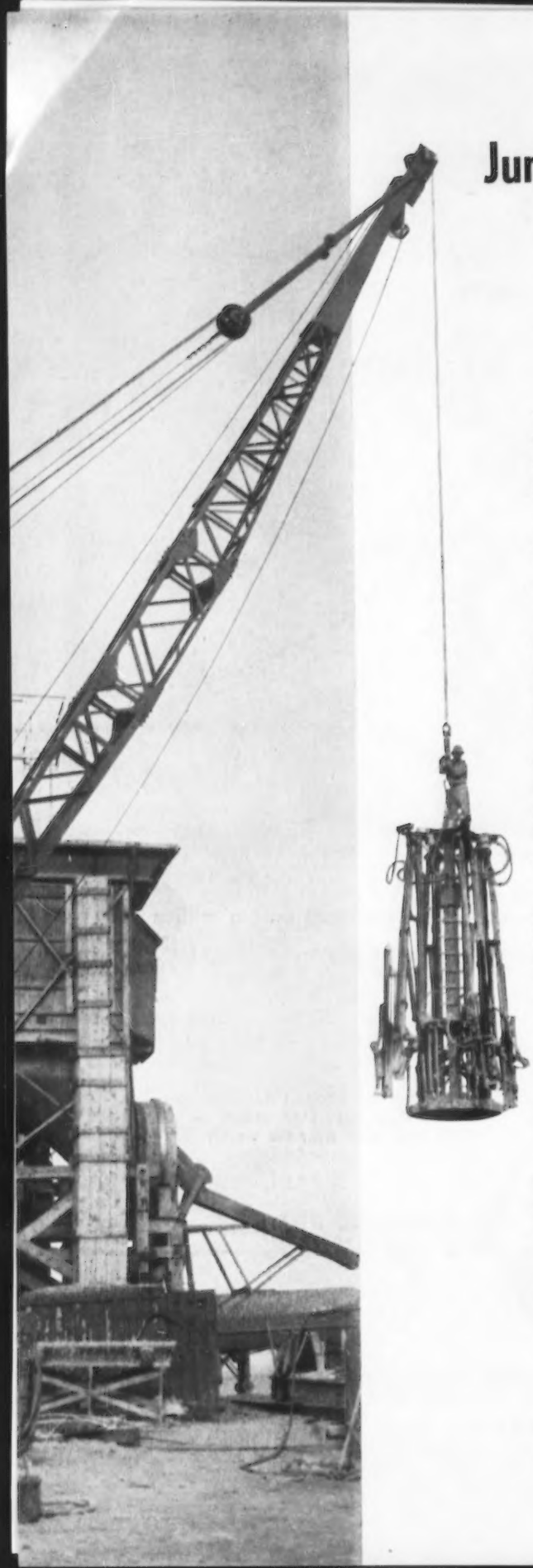
CARPCO CONSTRUCTION CORPORATION • CARPCO EXPORT CORPORATION
JACKSONVILLE, FLORIDA, U S. A.



Jumbo Sinks 18 Foot Diameter Shaft 10 Feet per Day!

Le Roi multiple drill rig speeds Wyoming mine project

"Only this Le Roi jumbo rig could make this kind of progress." That's the opinion of experienced mining engineers at the site of a new mine shaft near Green River, Wyoming.

Their job was to drive an 18 foot diameter ventilating shaft 1600 feet straight down through hard Wyoming rock. They did it in record time with a Le Roi Shaft Jumbo.

Le Roi's Shaft Jumbo is a self-leveling multiple drill rig. It has four extendible arms, each mounting a heavy sinker drill on an independently controlled 2-to-1 air-feed shell. Each arm is mechanically positioned by air motors.

On the Wyoming job, each round in the hard formations required 65 holes drilled to an average depth of 12 feet. The drilling pattern included a row of holes spotted around the perimeter, with successive inner circles offset for maximum shattering and fragmentation.

Each complete drilling sequence was finished by the Jumbo in an average of 3 hours. By using the feed shells, instead of hand-held jackhammers, steel changing was eliminated. On a 65-hole round, 12 feet deep, time saved was considerable . . . and multiplied by the shaft depth, amounted to real money!

In addition, drilling was much more accurate using the positive feed, air-motor positioned drills. This meant more accurate patterns. Worker efficiency increased, too. Easily controlled feeding eliminated the big source of worker fatigue.

The Le Roi Shaft Jumbo can drill shafts from a minimum diameter of 11'-9" up to a maximum diameter of 28'-0", and shafts have been sunk with the Jumbo to a depth of 3,000 feet. Normally equipped with 4 drills, the Jumbo can be furnished with 2 or 6, if desired. It is also available with dust collectors. For complete information, contact your local Le Roi distributor, or write us direct.

LE ROI Division of Westinghouse Air Brake Co., Milwaukee 1, Wisconsin, manufacturers of Cleveland air tools, Tractair, portable and stationary air compressors, and heavy-duty industrial engines. Write us for information on any of these products.

CYANAMID

REAGENT NEWS

"ore-dressing ideas you can use"

Now Commercially Available-- A More Economical Flocculant AEROFLOC® 550 Reagent

Cyanamid is pleased to announce a lower-priced, efficient flocculant —AEROFLOC 550 Reagent—to replace both AEROFLOC 548 and 552 Reagents with consequent savings to its customers.

Extensive laboratory testing and plant usage have indicated that AEROFLOC 550 Reagent is just as effective a flocculant as the products it replaces. In addition, increased production and improved manufacturing techniques have made possible substantially lower prices on AEROFLOC 550 Reagent—in the 58¢ to 63¢ per pound range, F.O.B. Woodbridge, New Jersey or F.A.S. New York, depending upon quantity and packaging.

Chemically AEROFLOC 550 Reagent is the same synthetic polymer as AEROFLOC 548 and 552 Reagents. It also has similar physical properties. Performance-wise AEROFLOC 550 Reagent is equal to or better than AEROFLOC 548 and 552 Reagents. Consequently, no changes in feed rate, solution strength or other operating procedures are involved in the change to AEROFLOC 550 Reagent.

AEROFLOC 550 Reagent is most effective on slime suspensions having a pH of 5 or above. For acid circuit flocculation, AEROFLOC 3000 Reagent is recommended.

Cyanamid field engineers will be pleased to furnish samples for test and to quote upon your requirements.

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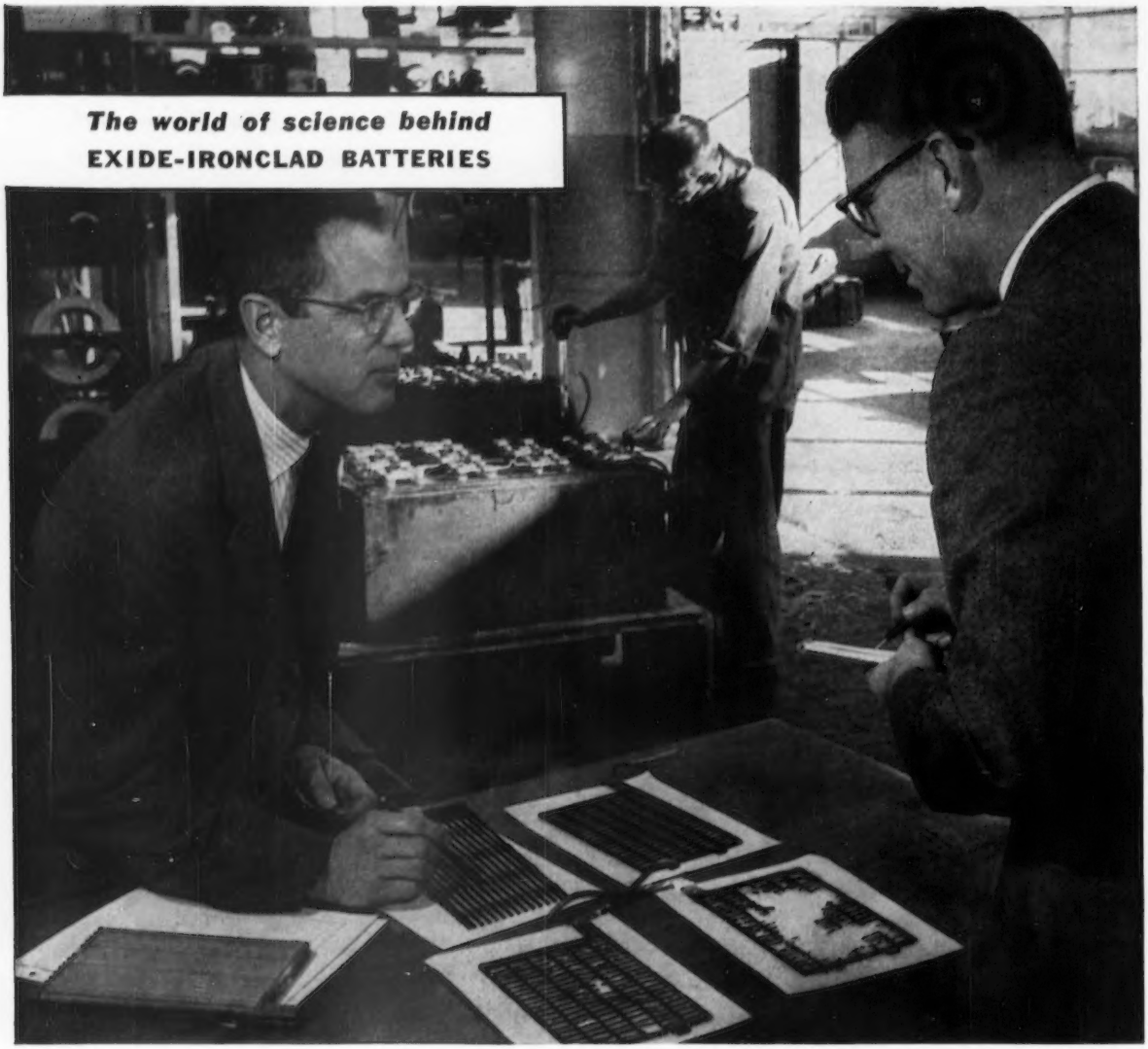
The world of science behind
EXIDE-IRONCLAD BATTERIES



Being interviewed is W. W. Smith, Divisional Manager, Product Engineering. Grids in back are of Exide's exclusive Silvium. Those in front are ordinary alloys.

"All of these alloys had the same acid test"

At the Exide Laboratories—**Reporter:** Was it a typical charge-discharge test normally used to test battery components?

Smith: Right. And the two positive plate grids with no visible signs of corrosion are Exide's patented Silvium alloy.

Reporter: How about the others—what alloys are they?

Smith: They're standard alloys used in other well-known makes of batteries. But they don't have Silvium's corrosion-resisting ingredients.

Reporter: Where is Silvium used?

Smith: In the positive plates of all Exide-Ironclad and many other Exide Batteries.

Reporter: How does it affect battery performance?

Smith: Every test we've made proves it stretches battery life because the grid resists corrosion—sometimes up to 100% longer.

Reporter: Obviously this is an important feature of the Exide-Ironclad.

Smith: Yes it is, but it's just one of many engineering details that contribute to its high capacity and long life.

Note to battery users: Whenever you order heavy duty batteries or the equipment that requires them, be sure to specify Exide-Ironclad. For detailed bulletin, write Exide Industrial Division, The Electric Storage Battery Co., Philadelphia 2, Pa.

THE ELECTRIC STORAGE BATTERY COMPANY **Exide**®

Yellow Strand

... always on hand

A Specialist helps you select the wire rope best for your job

You can depend on your Yellow Strand distributor for recommending the right size and type of wire rope — and for ample stocks on hand.

He knows exactly the rope to best fit your equipment for greatest wire rope service. He maintains stocks of standard strength Yellow Strand, Yellow Strand "POWERSTEEL" and Yellow Strand Flattened Strand to promptly supply your needs.

Add to that the extra qualities of wear resistance, shock resistance and long life manufactured into Yellow Strand products and you have a hard-to-beat combination.

Wherever your job may be Yellow Strand is near at hand. Distributors and factory warehouses are located throughout the entire U.S.A. Call them for the service of an expert, and longer rope life.

Where you see Yellow Strand at work, you'll see wire rope records of long life and dependability. Steady, day after day performance proves Yellow Strand's toughness, ability to "take" shock and wear of heavy loads.

Yellow Strand®

BRODERICK & BASCOM ROPE CO.

Manufacturers of Wire Rope for over 80 Years

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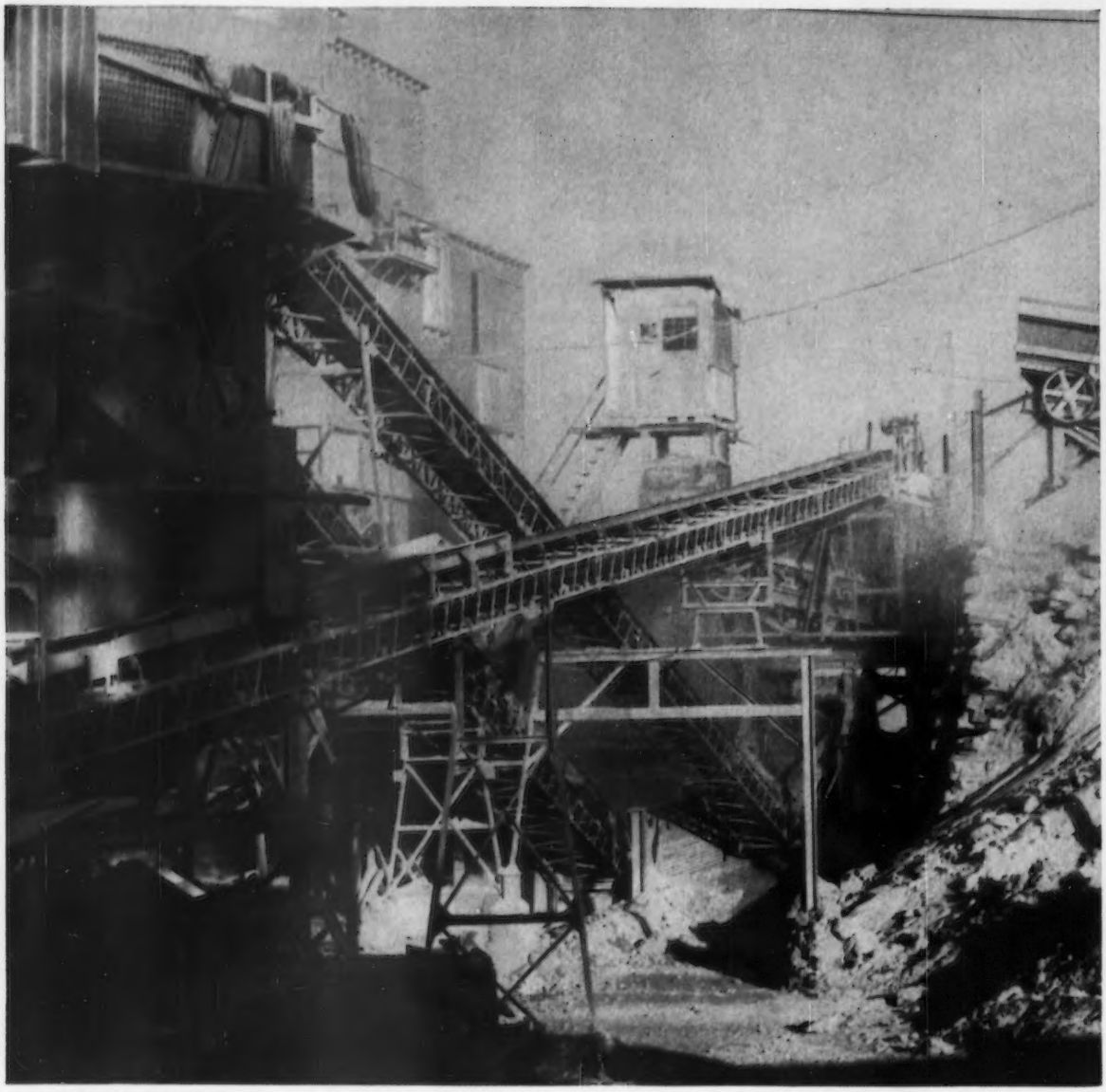


At Bradford Hills Quarry, Downington, Pa., equipment of Lukens "T-1" steel of 321 min. Brinnell hardness now handles 1000 tons of limestone daily—so far has lasted more than 18 times as long as metals previously used for the same purpose.

Lukens "T-1" Steel outlasts previous metals 18 to 1

TRADEMARK

Maintenance and replacement costs dropped sharply in chute liners, impact crusher caps, and similar parts when Bradford Hills Quarry switched to Lukens "T-1" steel. These critical parts once wore out in a month. Now they show little or no wear *after 18 months.*

Whether you handle stone, coal, or metal ores, Lukens "T-1" steel in areas hardest hit by punishing impact and abrasion will save you money too. Wear plates, dredge pump liners, storage bins, and fly-ash collectors are just a few typical applications.

Lukens "T-1" steel retains its remarkable combination of hardness and toughness at temperatures well below zero. *Look into it now. Write for informative illustrated booklet, "Lukens 'T-1' Steel." Address Manager, Marketing Service, Room 901, Lukens Steel Company, Coatesville, Pennsylvania.*

LUKENS ®

Helping industry choose steels that fit the job

105 Tractor—Excavator powered by 143 HP GMC Diesel engine can lift and load single pieces up to 12 tons.

THE EIMCO 105 EXCAVATOR LOADS MORE - FASTER . . CHEAPER

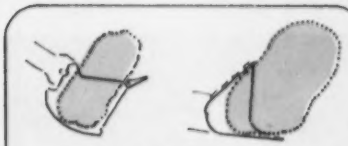
Eimco 105 Tractor-Excavators operate on a 10 to 12 second loading cycle. This speed can be maintained under ideal conditions.

Greater Capacity at 1/3 Initial Cost -

In tough conditions the 105 will out-perform other excavating equipment on a more impressive scale. It will pick up and discharge into the haulage unit much larger pieces of material than will go thru the bottom of a bucket on a boom shovel of equal (1½yd.) capacity.

The 105 will exert greater digging force at the bucket lip than the larger, more expensive boom equipment - often eliminating blasting. Equipment used around boom shovels such as bulldozers (for pushing up the broken rock) are eliminated with the Eimco 105 because this maneuverable tractor mounted excavator does its own bulldozing.

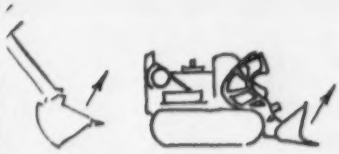
Eimco 105's are rugged, heavy duty machines, built to stay working on the job. Proven overall operating and maintenance costs are 40% less than boom shovels of same bucket capacity. Independent final drives provide greater maneuverability. Up-front position for the operator gives him full visibility. There are many other advantages in the 105. Write for complete information.



COMPARE

BOOM SHOVEL—EIMCO

11/2 yard boom bucket loading is limited to size that will go thru bucket. Eimco 11/2 yard bucket load is limited only to weight machine can lift.



COMPARE

BOOM SHOVEL—EIMCO

Digging effort on 11/2 yard boom shovel (45° boom angle bucket on ground) 24,000#. Digging effort on 11/2 yard Eimco shovel 39,200#.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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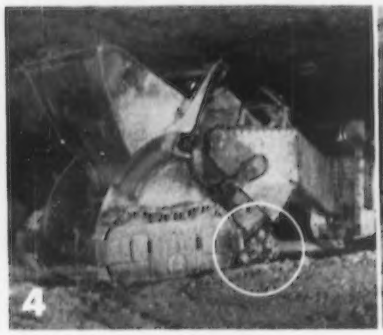
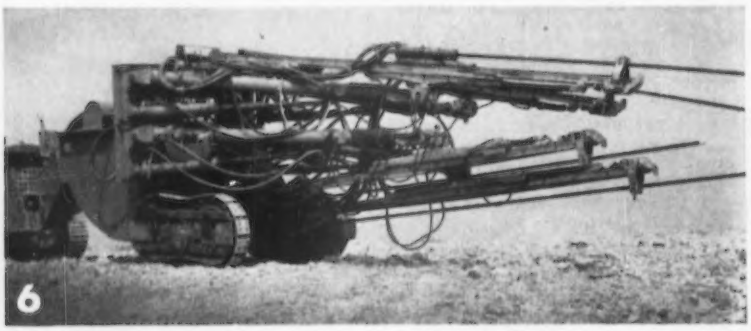
B-245

How Simple Gismo® Equipment cuts manpower in development and production work...

MINIMUM AMOUNT of equipment in stopes automatically reduces manpower to the minimum. Gismo unit consists of 4-drill jumbo and S-D Gismo Self-Loading mucking transport. Two men operate 4-drill jumbo; one man operates Gismo in the mucking operation.

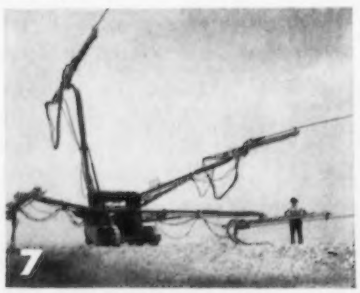


IN PRODUCTION or stope-work Gismo transports its loads and dumps directly into storage bin or ore pass as shown above, or ramping over present haulage equipment if haulage is now in ore bed. Same S-D Automatic Cars used for development work are used for haulage transportation from ore passes to hoisting facilities.



SAME GISMO mucking power unit is used to move 4-drill jumbo to new stope face or in development heading. (See Photo 6 above.) During drilling cycle in stope-work the Gismo power unit is used with mucking transport. Note in Photo 7 at right the reach of the 4-drill jumbo.

IN DEVELOPMENT Gismo loads directly into S-D Automatic Cars. (See Photos 2 and 3 above.) Two men operate 4-drill jumbo; one man operates Gismo and one man operates locomotive in car haulage.



As in all mechanization programs, proper supervision and maintenance programs should be set up. You may obtain complete information by writing ***Sanford-Day Iron Works, Inc., Knoxville, Tenn.***

SANFORD-DAY

KNOXVILLE, TENNESSEE

At A Sand Tunneling Project

AN EIMCO 630 DISPLAYS SPEED, POWER, VERSATILITY

Contracting firms at a large West Coast storm drain project employ a unique sand tunneling method that utilizes the loading speed and versatility of an Eimco 630 Crawler-Excavator.

The Eimco mucks at the base of a shield forced into the tunnel face by hydraulic rams bearing against the last set. The shield's broad apron sustains the ceiling and sides of the new cut until supports are installed.

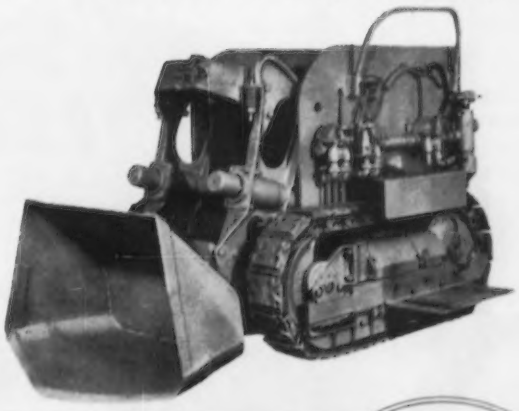
Here are some of the operating advantages being displayed by the Eimco 630:

1) **Loading Power . . .** Though procedure does not require blasting, material at the face is tightly packed. The Eimco's 6,000 pound digging power and independent track maneuverability (it crowds from any angle without making a new approach) are used advantageously to force the half-yard bucket into the face.

2) **Discharge Speed and Versatility . . .** The 630 reverses about 35 feet to discharge into a large hopper on side-mounted rails. To load in the cramped (10' rounded horseshoe) sections, the Eimco relies on overhead rocker arm discharge. While the machine moves from the face to the hopper, the operator gets the loaded bucket into dumping position . . . thus lost motion between excavating and discharge is held to a minimum. The Eimco traverses the 70 foot cycle and still dumps two cubic yards into the hopper every minute . . . enough to load a six (4 cu. yd.) car train every 14 minutes. Daily progress averages 35 feet.

3) **Dependable Service . . .** The Eimco is giving dependable on-the-job service while working in this abrasive sand . . . a real test of the machine's rugged and protective construction features.

The Eimco 630 is constantly meeting new challenges and getting greater tonnages at low operating costs. Watch it in action . . . then you be the judge!



THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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B-247

DART 10SL . . . Standard 10 tonner with submerged arc-welded box girder frame. 150 HP diesel driving through a double reduction rear axle. Tires are 12:00 x 20 all around. (Optional hydraulic steering, turbo charged engine and torque converter.)

SOLVE YOUR HAULAGE PROBLEMS with DART HEAVY-DUTY TRUCKS

In over 50 years of heavy-duty truck manufacturing experience, Dart has been a consistent leader in major truck design improvements. Designing trucks to meet specific haulage requirements is a Dart specialty . . . may we help *you* with your problems? No obligation.

STANDARD AND CUSTOM TRUCKS
10 TO 55 TON CAPACITIES
SINCE 1903

DART TONNAGE ENGINEERED TRUCKS
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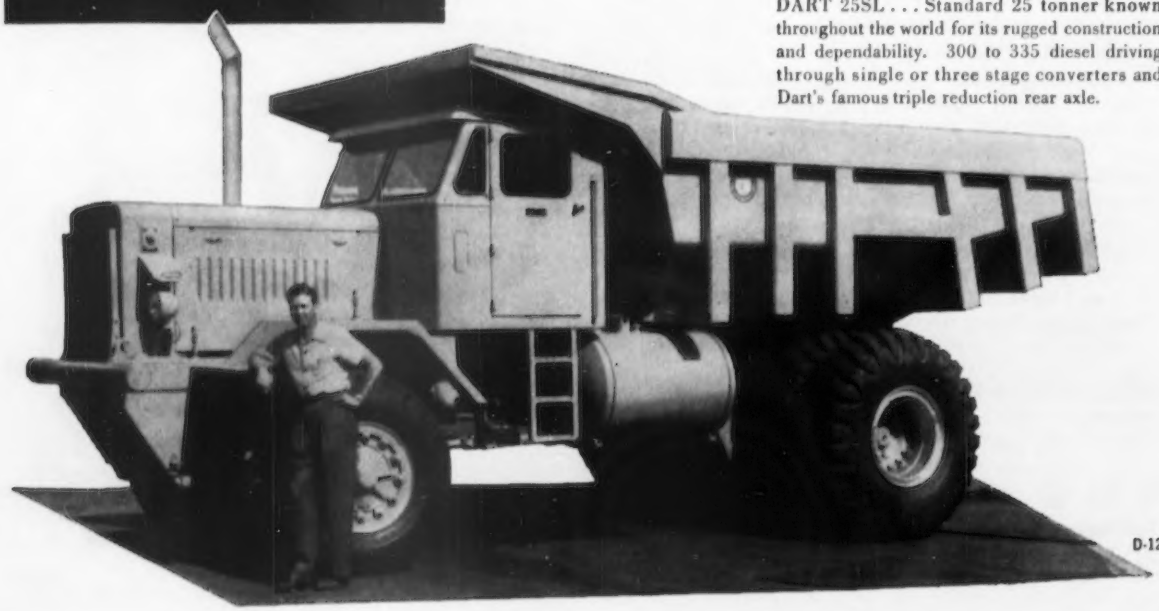
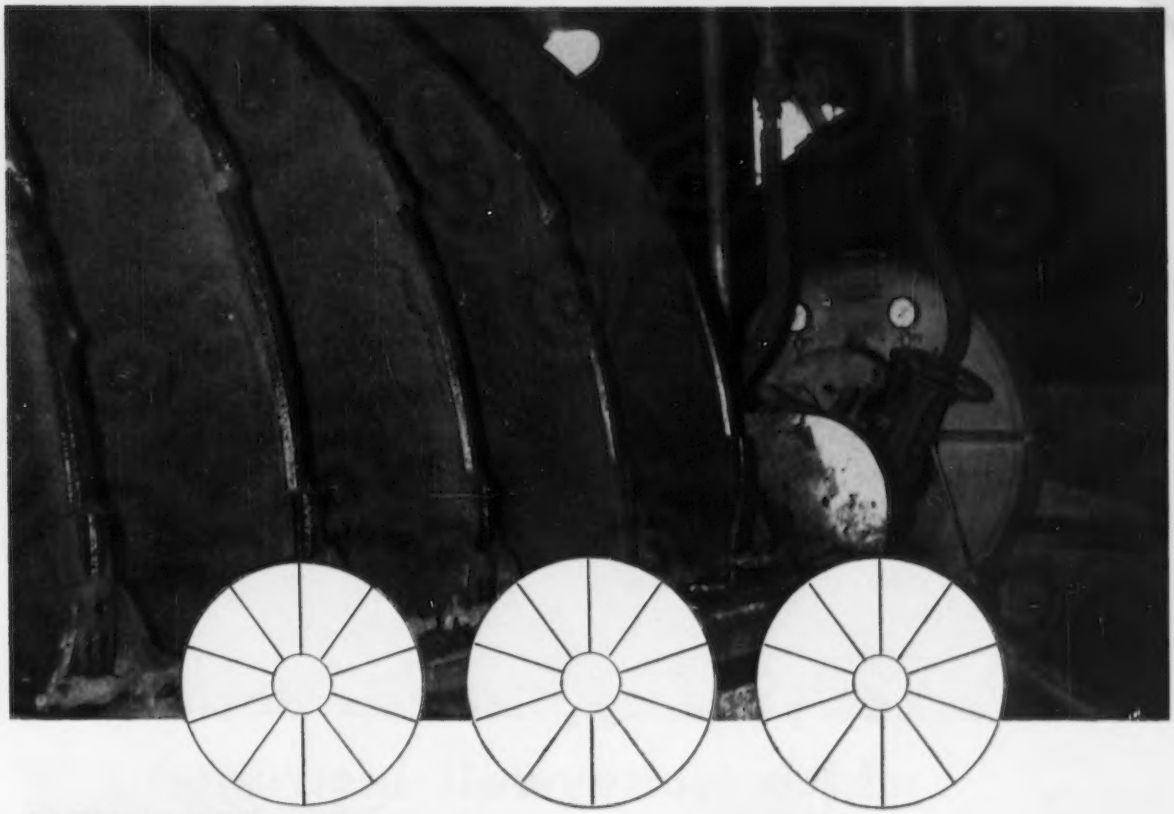
DART 25SL . . . Standard 25 tonner known throughout the world for its rugged construction and dependability. 300 to 335 diesel driving through single or three stage converters and Dart's famous triple reduction rear axle.



D-126

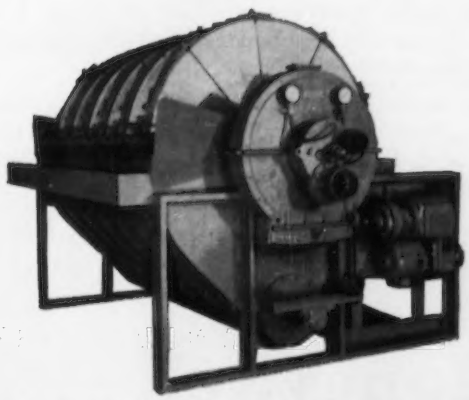


THREE FILTER DISCS

They LOOK the same – TRUE!

Yes . . . to the unobserving eye these three illustrations of widely-used filter discs appear identical. But—in operation—there's a sharp contrast in their filtering capacities.

From left to right—Disc one is 8' 6" in diameter with **94** square feet of filter area . . . Disc two is 8' 10" in diameter with **104** square feet of filter area . . . Disc three is an 8' 10" diameter **EIMCO** disc with **110** square feet of filter area.



They ARE the same – FALSE!

Eimco's close attention to detail and superior engineering in disc design, get you more square feet of filter area per dollar of capital investment than any competitive make.

For example—Flow rate requirements of a processing firm called for 650 square feet of disc filter area. Eimco met production level requirements with **a six** disc filter while others were forced to specify a **seven** disc filter. **Since the price for each disc is essentially the same, Eimco saved this firm the cost of one disc.**

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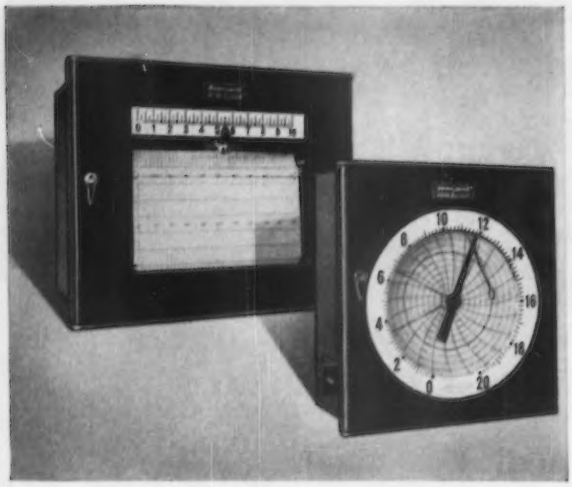

Precision Class 15 Line of *ElectroniK* instruments. Calibrated accuracy, ± .25% of span. Complete selection of many types of indicating and recording models, including electric and pneumatic controllers of most advanced type, and multipoint monitoring or recording of 2 to 400 points.

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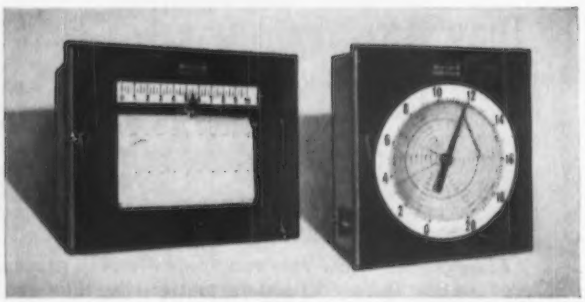
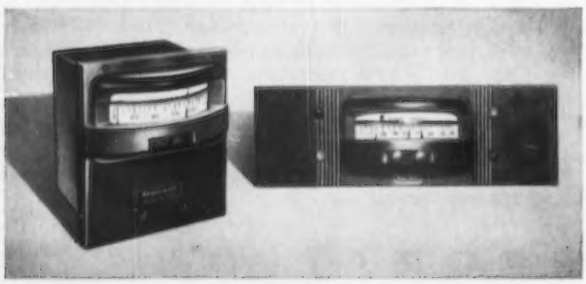


Special Class 14 Line of *ElectroniK* instruments. Calibrated accuracy, ± .5% of span. Priced lower than the Precision line. Strip chart and circular chart instruments, circular scale indicating controllers. With various types of electric control.



Millivoltmeter Instruments. Dependable, accurate service at low cost. Plug-in unit design speeds servicing. *Pyr-O-Vane* controllers, in either horizontal or vertical case, offer snap-action or time-proportioning electric control.

No need to "shop around" for instrumentation to fit your temperature measurement or control problem. From the Honeywell line—the most complete and diversified in the industry—you can be sure of getting exactly what your application requires.

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M-S-A Type D ALL-WEATHER FIRST AID KITS

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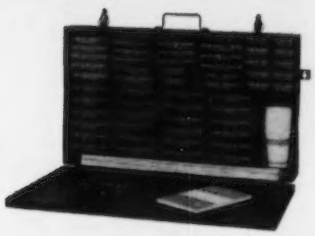


M-S-A MINER'S FIRST AID CABINET

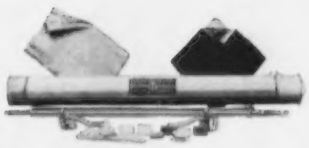
Contains complete assortment of first aid material and supplies. Ideal for mine hospital or dressing stations. Contents conform to U. S. Bureau of Mines recommendations.

M-S-A FOILLE BURN KIT

Contains four 10-ounce Foille Aerosol Sprays, easy-to-use Type D first aid dressings and accessories. Stored in All-Weather steel case. Permits fast effective burn treatment.

M-S-A EMERGENCY FIRST AID OUTFIT

Ideal for storage underground where a compact unit is needed. Contents selected to meet practically every emergency. Includes two first aid kits, blankets, splints, Redi-Heat Blocks, stretchers. Sturdy steel case.



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Complete assortment of first aid dressings and supplies arranged in a strong dust-proof canister. Contains stretcher, blankets, first aid materials, splints. Designed for first aid rooms, dressing stations.

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Our knowledge of emergency needs has developed the design and contents of our first aid line.

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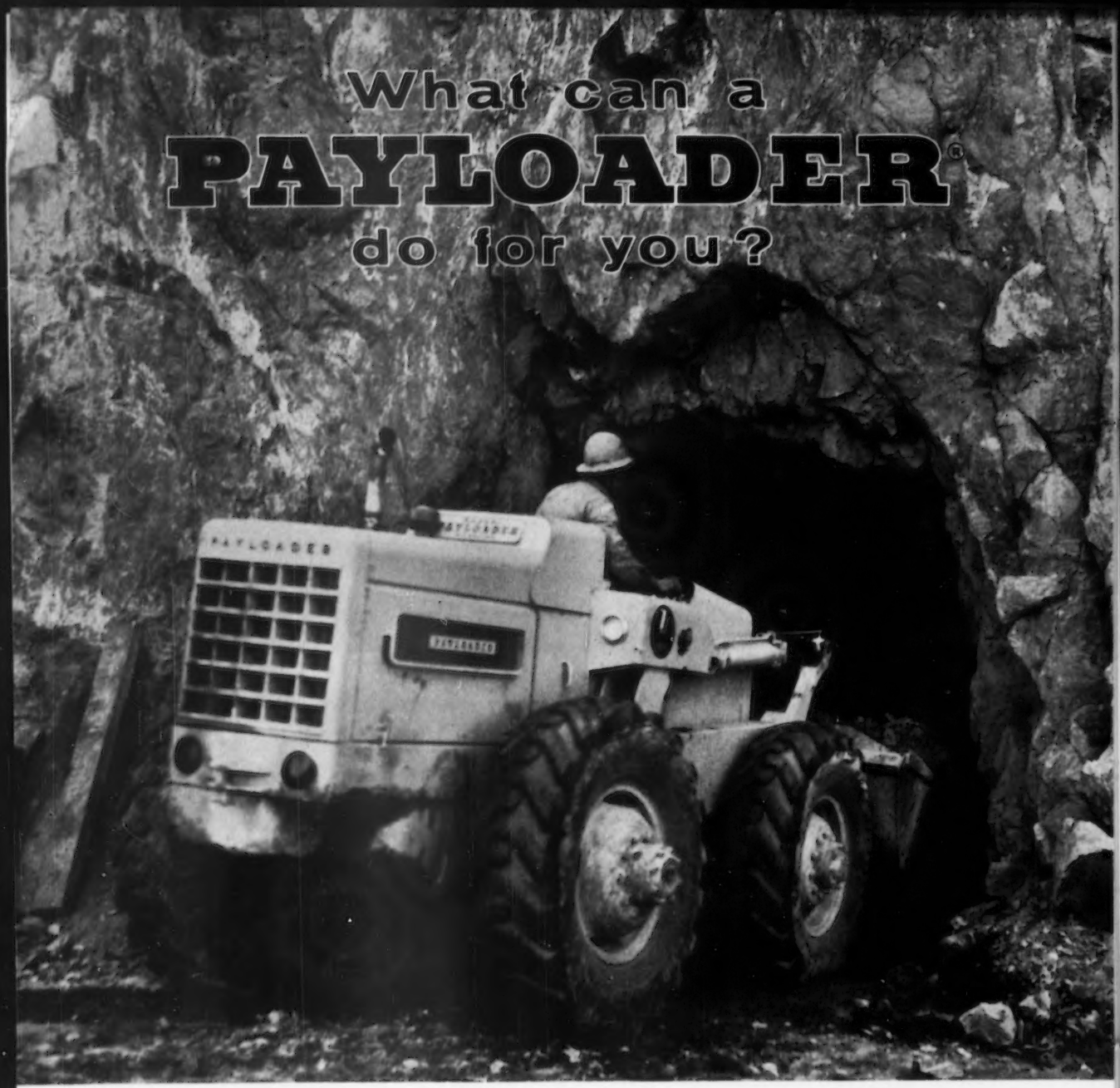

Versatility — the ability to do many earth and material handling jobs, and ***mobility*** — the speed and ease with which they get to the job, are big reasons for the success and acceptance of rubber-tired tractor-shovels at pits, plants and tipples. Mining men also like rubber-tired equipment because it doesn't chew and grind surfaces and greatly reduces dust conditions.

And among rubber-tired tractor-shovels, none can match the versatility, mobility and productive capacity of the new four-wheel-drive "PAYLOADER" units, size for size.

More reliable traction . . . easier, faster and safer operation . . . greater digging power . . . more carrying capacity, are some of the many outstanding improvements in these four-wheel-drive units that are making friends every day among mining operators who know tractor-shovels best.

Your "PAYLOADER" Distributor wants you to prove on your own work that these new "PAYLOADER" models are the most useful, productive and profitable tractor-shovels you can own. Call him today for a demonstration.

It can strip overburden or clean off veins . . . spread, windrow or stockpile . . . carries its bucket loads and puts them where needed.

It can dig payloads of light *or* heavy materials . . . thanks to tremendous pry-out, break-out force and 40° tip-back of bucket at ground level.

It can spot and switch cars — walk across tracks. Ready pushing and pulling power to boost stalled trucks and skid equipment.

It can load gondolas, trucks, hoppers and conveyors . . . travels fast with heaped loads carried low and close for safety and stability.

Full of "MORE YARDAGE" features

Exclusive power-transfer differentials provide sure-footed traction on mud, gravel, ice and snow.

Hydraulic load-shock absorber cushions the loaded bucket, smooths the ride—permits higher carry speeds with less spillage.

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Owners expect more from a "PAYLOADER" and they get more because more of them are in service than all other makes combined. They're designed right and built right . . . they're sold and serviced right by a nearby "PAYLOADER" distributor.

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Grizzly Feeder

By-passes fines ahead of primary and secondary crushers, screens, picking belts. Safeguards belts by bedding them with fines, absorbing impact and preventing damage.

Vibrating Feeders

To meet all capacity requirements and for handling most classes of materials. Jeffrey feeders can be furnished with various styles of decks and in types to satisfy all operating conditions; dust-tight, spark-proof, etc.

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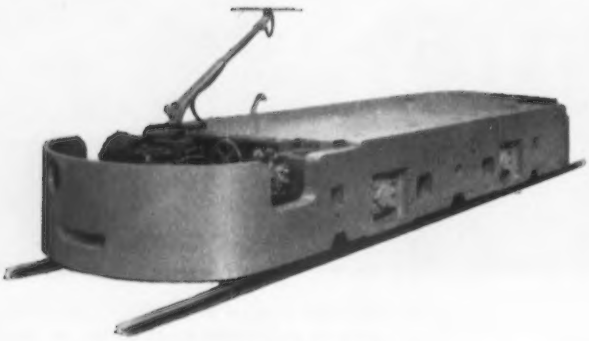

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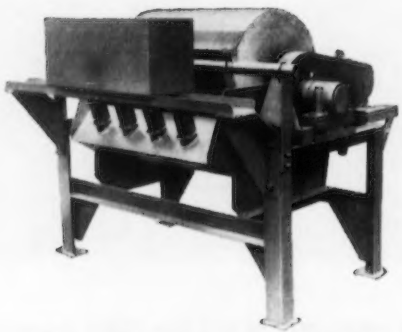
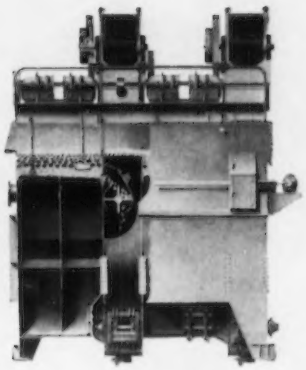
Sturdy, streamlined, easy to operate and maintain, Jeffrey locomotives are known throughout the world for their reliability and long-term service. Available in trolley, cable reel and storage battery types, in sizes to suit your requirements.



Magnetic Separators

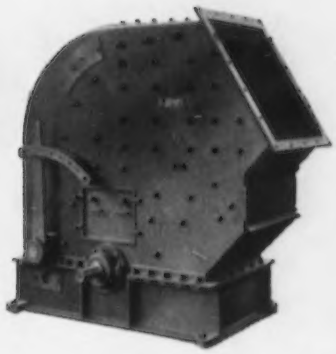
Solve wet concentration and magnetic recovery problems. Of the wet drum type, with only this one moving part, Jeffrey separators and cobbers are simple to operate. One supervisor can take care of a 70-unit plant. They're highly efficient.

and processing.....



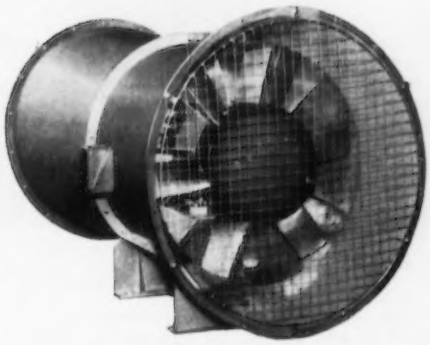
Baum Jigs

Ideal as a final concentrator or as a rougher ahead of flotation. Jeffrey air-operated jigs give exceptionally high capacity per unit of area, often ten times that of conventional plunger jigs. For years they've been handling some of the toughest separation jobs.



Rock Buster

A hard-hitting giant that's suitable for crushing large primary feed—everything that comes from the face, without preliminary sizing or picking. Also available from Jeffrey are other crushers in types and sizes to meet every sizing requirement.



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Jeffrey makes fans for every mining condition—midget blowers for auxiliaries, junior models for low pressure work, and mammoth multi-stage units for high pressure, high volume service. Jeffrey engineers assist in their selection.

Belt Conveyors

A few feet long or extending miles, underground or across country, belts run smoothly with Jeffrey equipment and drives. A complete range of sizes and capacities to meet all handling operations is available through Jeffrey.

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Gives 64% faster lubrication than hand methods—saves maintenance time and costs!

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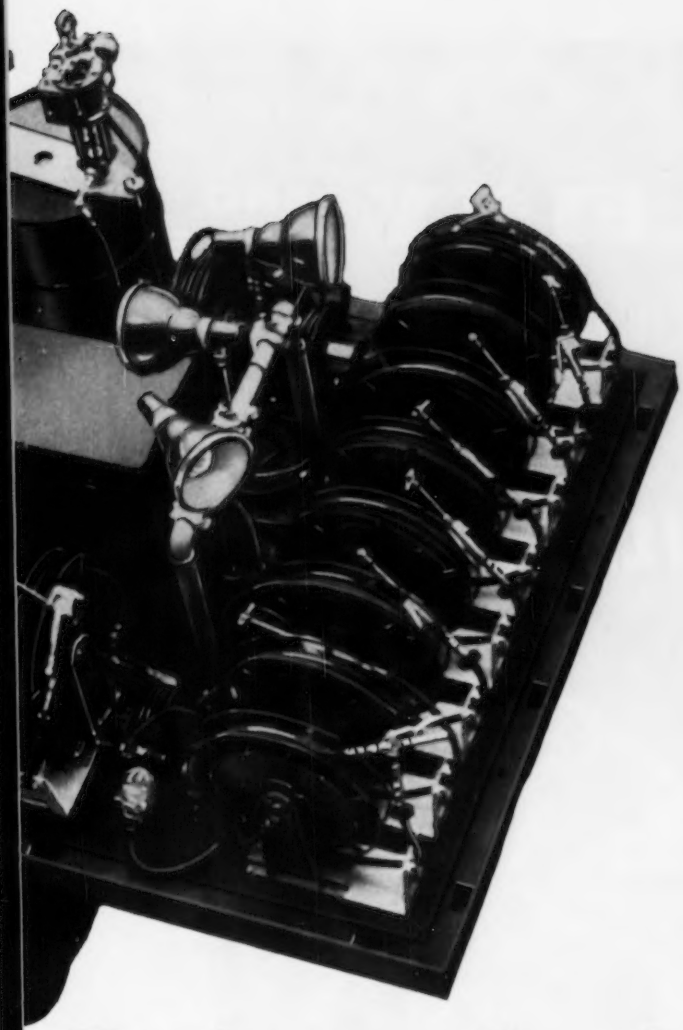
An Alemite Portable Service Station pays for itself by saving your time, money and equipment. An outfit rigged especially for your needs can easily be selected from standard Alemite equipment. Here's how it works:

1. You choose the truck that fits your needs for size, power, terrain.

2. A standard air compressor is installed—usually behind the cab.

3. Alemite Barrel Pumps are added to handle pressure gun and gear lubricants, motor oils, that you will use.

4. A bank of Alemite hose reels are added. They reach out in a 40-ft. working radius to service your rigs right on the job.



Right to the Job!

Fast, easy, high-pressure lubrication of all bearings equipped with hydraulic or button-head fittings!

Quick filling of final drives, gear housings, transmissions!

No engine oil wasted — delivers exact amount of oil required!

Air line equipment for on-the-job tire inflating, air cleaning!

Alemite "On-the-go" Lubrication Has Helped Major Construction Companies Meet Tight Schedules on Those Major Projects:

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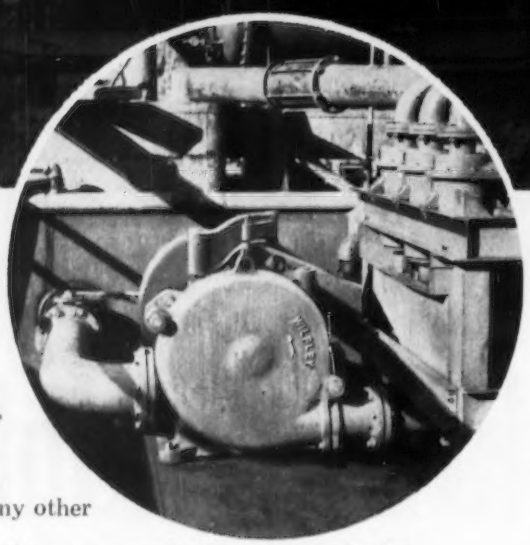

The multiple cyclone unit, used in this oil drilling operation for removing sand and abrasive solids from drilling muds, makes possible 20% faster drilling, increased bit footage, 25% longer runs, reduced mud pump maintenance and many other cost-saving advantages. A vital factor in the economy of this operation is the **Wilfley Sand Pump** which provides: **maintained high efficiency; continuous, trouble-free operation without attention; simple and speedy replacement of long-wearing parts.**

Another example of Wilfley's contribution to lower operating costs throughout industry.

Wilfley Sand Pumps
"Companions in Economical Operation"
Wilfley Acid Pumps

Individual Engineering on Every Application. Write, wire or phone for complete details.

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ENGINEERING AND MINING JOURNAL

APRIL 1957

Mining's Great Contribution To Society

SINCE THE START of World War II, the mining industry has gained great recognition for its contributions of metals and minerals to the "sinews of war," the advance of industrialization and subsequent defense programs set up to buffer threats to world Democracy. Large institutional advertisements are telling the public how the industry is developing new properties and expanding production to meet demands for copper, nickel, steel, etc., for decades to come.

Without question, there is much merit in these programs telling the public about mining's important role. However, we believe greater emphasis should be placed on some of the collateral benefits that mining offers to society.

In Canada, the United States and Latin America, mining companies have to do much more than develop mines and treat the ores. They often develop their own power; build their own roads; construct their own townsites; establish schools and places of worship; train unskilled employees; provide hospitals and staff them with skilled surgeons and nurses; and raise cattle, sheep, citrus fruits and other food supplies to supplement the meager diets in undeveloped countries.

Note for instance on page 96 how Cerro de Pasco has driven a $5-million highway through the rugged Montaña area of central Peru to establish a $25-million, 72,000-kw, hydroelectric power project. The potential economic value of this project can be appreciated when you realize that 1 kwh of energy at Cerro is required to produce about 5 lb of lead, 1.25 lb of copper or 0.5 lb of zinc. Hence expanded power capacity means increased metal output, job opportunities, etc., in Peru.

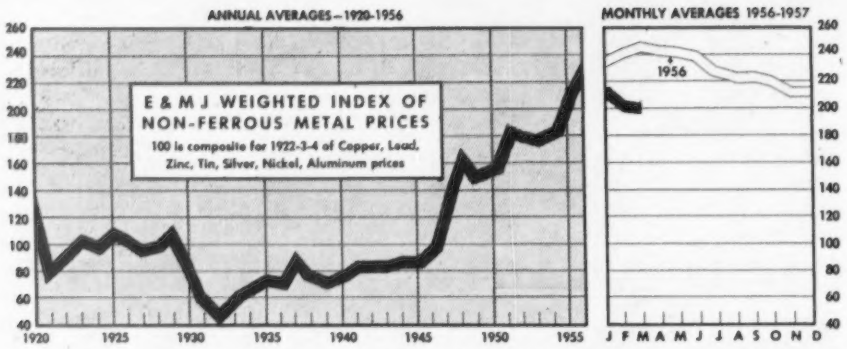
To the south, in Peru we now see railroads, docks power lines, mine shops under construction at the Southern Peru Copper project. Stripping rates are being accelerated. Here too, the company is providing the usual auxiliary facilities such as townsites, hospitals, water lines, transportation, farm areas for food supply, etc., for the comfort and good living standards of employees.

It is exceedingly important that these fine contributions of mining companies to society be publicized at this time, not in a spirit of boastfulness, but to combat the festering efforts of Communist trouble-makers now at work in many Western Hemisphere countries. All the Communists do is spread seeds of discontent. Nowhere in Latin America will you see a doctor from Communist Russia perform operations on unfortunates requiring medical care. But you can walk into any mine hospital in Peru, Chile, Argentina or Venezuela and see doctors from those countries, Free Europe, or the U. S. performing skilled operations on men, women and children, many of whom do not even come from the families of workers.

We believe that these fine contributions to human welfare, if modestly publicized, will go far to establish the real superiority of free Western dynamic industrial society over the theoretical and thus far unworkable society of Soviet Communism.

E&MJ OUTLOOK

PRICES



MARKETS

Declining copper prices and a slight drop in tin prices depressed the *E&MJ* metal price index from 206.66 during February to 203.36 for March. All other non-ferrous metals were on the firm side during the month.

The long slide in copper prices since early 1956 is being arrested. Month-end strikes in Canada and Chile, plus announcements of cut-backs in production from high-cost domestic mines are firming influences. Renewed industrial production in Europe as a result of the re-opening of the Suez Canal may also strengthen demand.

●

AT HOME

McGraw-Hill's Department of Economics believes that accelerated salesmanship is all that is needed to boost the "sidewise movement" in the production of consumer goods that has been going on for the last six months. Reason: consumer income has continued to rise for the past six months or more.

House Appropriation Committee's recent slash of $130-million in funds for stockpile purchases of critical and strategic materials has stirred up a furor among mining state Senators and some Western Congressmen. Although the Senate may put some of the funds back, little more than a compromise is expected at present.

High-energy boron-base fuels may rival petroleum as a source of energy for future jets and turbines according to recent news reports. Callery Chemical Co. is building a $38-million plant in Oklahoma to produce these new fuels, and Olin Mathieson is building a $33-million plant at Niagara Falls, N. Y., to produce "exotic" boron-base fuel.

●

LABOR

International Union of Mine, Mill and Smelter Workers, traditionally a supporter of free world trade, indicates that it is ready to support Sen. George W. Malone in a move for higher tariffs on copper. Sen. Malone advocates that all tariffs be set by the Tariff Commission instead of the President, and that the Trade Agreements Act be allowed to expire June 1958.

Productivity is expected to be the new bargaining weapon labor will use in future negotiations. If so, labor, Government and management will have to have something better to work with than the nebulous figures published to date.

●

ABROAD

Newmont Mining Corp. and Rio Tinto are showing interest in a potential $75- to $90-million copper project at Phalaborwa Transvaal, Africa. A new firm, made up of Rio Tinto, Newmont and American Metal Co. will spend an initial $3-million to investigate the find.

Canada's Royal Commission on Economic Prospects predicts that by 1980 the country will be producing about twice as much copper, four times as much iron and five times as much aluminum as it did in 1955. It is estimated that only 20% of the potential mineral prospecting ground has been explored, and that only a quarter of Canada's potential hydro-electric power is now being utilized.

MARKETS

Copper Strikes Strengthen Market; Lead and Zinc Quiet; Tin Stronger

INDUSTRIAL PRODUCTION in March may drop slightly from the February level. The February Federal Reserve seasonally adjusted index was 146% of the 1947-1949 average, equal to the January index and one point under the December figure. The March figure may slip to 145% owing to the decline in steel output.

Nonferrous metal prices dropped further in March. The *E&MJ* index was 203—36% of the 1922–1924 average; in February it was 206.66%. The decline was the result of the average copper price fall to 31.452c from 32.576c. Tin dropped about one cent but owing to its low weight it had little effect on the index.

Copper markets firmed the last few days of March and the first few of April. The Mufulira (Rhodesia) copper strike of European workers has shut off about 9,000 tons per month; the Braden strike means a cut of about 12,000 tons (owing presumably to the seasonal water shortage Braden has not been in full production); the Gaspe, Canada, strike has been cutting output at a monthly rate of about 2,200 tons, and the strike vote at the Noranda property, if followed by a strike, would mean a loss of 8,500 tons a month.

The strengthening was first obvious Monday, March 25, when Roy H. Glover, chairman of the Anaconda Co., said Anaconda was closing two mines in Montana with a total output of 2,000 tpm. The Gaspe strike began Mar. 10 and may have prevented prices from dropping even more. The low for spot in London was reached Mar. 22. Bid was then £235 in the afternoon session—this was about 29.3c per lb at the existing exchange rate. Apr. 1 afternoon spot bid was £245½, about 30.7c. Sales on the curb later that day were made at £247.

Custom smelters in the U. S. were selling at 31c delivered Mar. 1; by Mar. 22 sales were made at 30½c. Sales at this price were also made on the last day of March. But at least one smelter received 31½c for copper on that day. On Apr. 1 heavy amounts were sold at 31c. Most dealers before the end of the day were asking 31½c.

Katanga had reached about 29.4c f.a.s. New York by Mar. 21; Apr. 2 it raised to 29.85c—30.75c in Europe.

No. 2 copper scrap prices rose to about 26c—they had been as low as 24½c.

The stronger market situation in Europe partly reflected buying by at least one large producer on the London Metal Exchange. There was also some thought the international situation caused some buying that would otherwise have not occurred.

March reports by copper sellers to *E&MJ* of pricings were higher than for February and about equal to January. Copper Association reports for March show sales for March delivery in the U. S. well above February comparable figures. But March figures for sales for the next month—April—are not much different from the comparable figures of last month.

Reports of foreign sales to *E&MJ* for the last three days of March were 18,741 tons—this higher-than-normal figure reflects the heavy European buying that usually accompanies strikes or other market disturbances.

U. S. copper fabricator data for February 1956 and January and February 1957 follow:

	1956 Feb.	1957 Jan.	1957 Feb.
Fabricator activity			
Shipments	130,973	119,517	114,341
Sales	107,345	114,009	114,904
Unfilled orders	282,314	178,326	178,889
Fabricators' refined copper			
Stocks	388,823	435,635	422,223
On order	135,637	107,231	110,174
Receipts	139,433	119,925	101,565

Copper Institute data follow:

United States			
Production:			
Crude, primary	(a)	94,873	92,242
Crude, secondary	(a)	14,683	8,790
Total	(a)	109,556	101,032
Refined copper		139,150	134,119
Deliveries, refined		119,925	101,565
Stock at end, ref'd		118,564	136,330
Outside United States			
Production:			
Crude, primary	(a)	146,097	143,317
Crude, secondary		831	1,636
Total	(a)	146,928	144,953
Refined copper		117,579	108,661
Deliveries, refined	(a)	143,089	113,231
Stock at end, ref'd.	(a)	226,408	233,626

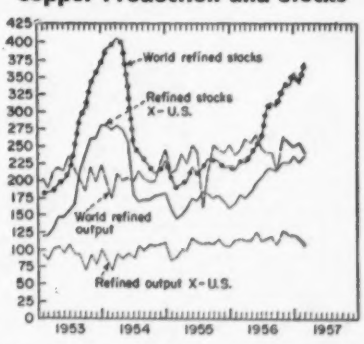
(a) Corrected

Lead sales in March were better than in February but about the same as in January. Producers say business is not good. Late in the month the Government asked for tenders and accepted much less than it was offered. In February it was shipped about 2,800 tons and in January about 8,100 tons. Shipping dates end in the middle of the month for each order so purchases probably do not reflect relative amounts bought; but few expect purchases of more than 3,500 tons. American Bureau of Metal Statistics data follow:

	1956	Jan. 1957	Feb. 1957
Stock, beginning	31,089	41,181	42,905
Production	613,293	50,854	47,912
Total supply	644,382	92,035	90,817
Shipments:			
U. S. consumer	524,848	40,549	37,517
Exports	4,051	450	1,957
(a) Other	74,302	8,131	2,744
Total	603,201	49,130	42,118
Stock at end	41,181	42,905	48,599

(a) Presumably U. S. Government

Copper Production and Stocks



Data are from the Copper Institute and are in thousands of short tons. They include Feb. 1957. The two series "X-U. S." are the world producer statistics less the U. S. No fabricator stocks are included.

Zinc sales in March were little changed from February and well under January. The Government asked for tenders late in the month and probably accepted less than in previous months.

Aluminum markets remain rather quiet. Reynolds has arranged to sell another 10,000 tons to the Government under the agreement entered into when it expanded its facilities. This makes 25,000 tons for Reynolds for the first quarter; Kaiser sold the same amount.

All of Alcoa's plants were scheduled to be back in production in the Northwest by Apr. 1; the Kaiser Meade plant is back in production and the Trentwood plant is expected to be back soon. Reynolds was scheduled to have both the potlines it had closed back in operation by Apr. 1.

Aluminium Ltd. is now producing somewhat more than it is selling, its president reports. This permits the company to develop new markets, he said.

The Tin Council raised its "floor" prices. The manager of the cartel's buffer stock must buy when the price is under 91¼c; he may buy from 91¼c to 97½c; he is out of the market from 97½c to 103¾c; he may sell from 103¾c to 110c and he must sell when the market is above 110c.

U. S. Government mineral program has not been announced. The economy minded House voted to eliminate the 1958 fiscal year stockpile buying funds. The Administration had proposed $130-million. The Senate, which is less concerned about high Government spending, may put some back. There is $145-million left over from past appropriations that can be used in fiscal 1958 (begins July 1, 1957). The expected House–Senate joint committee meeting to consider the request for $30-million for buying fluorspar, tungsten ores, asbestos and columbium was again postponed. One major U. S. tungsten ore mining firm, Minerals Engineering Co., has arranged to sell ore to consumers through Associated Metals and Minerals Corp.

MARKETS *(Continued)*

Average Prices March (*E&MJ* Quotations)

Copper:	
Electrolytic, domestic refinery	31.452
Electrolytic, export refinery	29.555
Lead:	
Common, New York	16.000
Common, St. Louis	15.800
Silver and sterling exchange:	
Silver, New York, per oz.	91.375
Silver, London, pence per oz.	79.744
Sterling Exchange, "Checks"	279.305
Zinc:	
Prime Western, East St. Louis	13.500
Prime, Western, delivered (g)	14.000
Tin:	
New York Straits	99.577
Gold, per oz. U. S. price	$35.000
Quicksilver, per flask	$255.000
Antimony, *(E&MJ)* (d)	36.590
Antimony, bulk, Laredo	33.000
Antimony, in cases, Laredo	33.500
Platinum, refined, per oz.	$93.000
Cadmium (a)	170.000
Cadmium (b)	170.000
Cadmium (c)	170.000
Aluminum, 99% plus ingot	27.100
Magnesium, ingot	35.250
Nickel (f)	74.000

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.

(a) Cadmium average based on the producers' quotations.

(b) Cadmium average based on the average of the producers' and platers' quotation.

(c) Cadmium average based on platers' quotation.

(d) Domestic, 5 tons or more but less than carload lots, packed in case f.o.b. New York.

(e) Tin content.

(f) Contract price, f.o.b. Port Colborne, U.S. duty included. Other regular sellers 78¼¢ to $1.25.

(g) Delivered where freight exceeds 0.5c.

"Free" Gold Market

Gold transactions increased 37% in March. Soviet sales were reported to total $180-million so far in 1957. European dealings were brisk; transactions rose in Paris and in Switzerland. Djakarta had heavy turn overs and higher prices on currency unrest. Manila showed active trading. Asiatic and South American markets were quiet with lower coin and bar prices. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	COINS		BARS (12.5 kg)	
	Feb. 28	Mar. 31	Feb. 28	Mar. 31
NEW YORK, transit	.....	.....	$35.08	$35.08
MANILA	$43.80	$43.50	36.20	36.30
HONG KONG	41.85	42.50	38.10	38.05
BOMBAY	58.00	57.50	57.50	57.00
TANGIER	42.50	43.00	34.88	34.90
BEYROUTH	45.20	43.50	35.04	35.07
PARIS	46.25	44.15	36.20	36.10
BUENOS AIRES	39.25	38.75	35.40	35.30

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Major Metals

U. S. DAILY AND AVERAGE PRICES

Mar. 1957	Electrolytic Copper (a) Domestic	(b) Export	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99%	Straits Tin New York
1	31.550	29.800	16.000	15.800	14.000	13.500	25.000	98.375
2	No Market	29.800	16.000	15.800	14.000	13.500	25.000	98.375
4	31.525	29.925	16.000	15.800	14.000	13.500	25.000	98.625
5	31.525	30.050	16.000	15.800	14.000	13.500	25.000	98.625
6	31.575	30.300	16.000	15.800	14.000	13.500	25.000	98.875
7	31.575	29.825	16.000	15.800	14.000	13.500	25.000	99.250
8	31.525	29.925	16.000	15.800	14.000	13.500	25.000	99.375
9	No Market	29.925	16.000	15.800	14.000	13.500	25.000	99.375
11	31.575	30.025	16.000	15.800	14.000	13.500	25.000	98.875
12	31.575	29.700	16.000	15.800	14.000	13.500	25.000	99.125
13	31.600	29.775	16.000	15.800	14.000	13.500	25.000	98.875
14	31.450	29.675	16.000	15.800	14.000	13.500	25.000	99.375
15	31.550	29.625	16.000	15.800	14.000	13.500	25.000	100.125
16	No Market	29.625	16.000	15.800	14.000	13.500	25.000	100.125
18	31.300	29.450	16.000	15.800	14.000	13.500	25.000	99.625
19	31.425	29.225	16.000	15.800	14.000	13.500	25.000	99.625
20	31.575	29.125	16.000	15.800	14.000	13.500	25.000	99.750
21	31.400	29.450	16.000	15.800	14.000	13.500	25.000	100.125
22	31.500	28.900	16.000	15.800	14.000	13.500	25.000	99.500
23	No Market	28.900	16.000	15.800	14.000	13.500	25.000	99.500
25	31.325	28.950	16.000	15.800	14.000	13.500	25.000	102.125
26	31.250	29.200	16.000	15.800	14.000	13.500	25.000	101.625
27	31.425	29.100	16.000	15.800	14.000	13.500	25.000	101.000
28	31.100	29.350	16.000	15.800	14.000	13.500	25.000	100.250
29	31.175	29.400	16.000	15.800	14.000	13.500	25.000	99.250
30	No Market	29.400	16.000	15.800	14.000	13.500	25.000	99.250
AVERAGES FOR MONTH								
Mar.	31.452	29.555	16.000	15.800	14.000	13.500	25.000	99.577
AVERAGES FOR WEEK								
Mar.								
6	31.510	29.933	16.000	15.800	14.000	13.500	25.000	98.521
13	31.570	29.863	16.000	15.800	14.000	13.500	25.000	99.146
20	31.460	29.454	16.000	15.800	14.000	13.500	25.000	99.771
27	31.380	29.083	16.000	15.800	14.000	13.500	25.000	100.646
CALENDAR WEEK AVERAGES								
Mar.								
2	31.380	29.696	16.000	15.800	14.000	13.500	25.000	98.250
9	31.545	29.992	16.000	15.800	14.000	13.500	25.000	99.021
16	31.550	29.738	16.000	15.800	14.000	13.500	25.000	99.417
23	31.440	29.175	16.000	15.800	14.000	13.500	25.000	99.688
30	31.255	29.233	16.000	15.800	14.000	13.500	25.000	100.583

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Mar. 1957	Silver (c) New York	Silver London	Sterling Exchange "Checks"	Gold London	Gold (d) United States
1	91.375	80.000d.	279.6562	249s. 5½d.	$35.00
2	(e)	(e)	(e)	(e)	35.00
4	91.375	80.000d.	279.6250	249s. 6½d.	35.00
5	91.375	80.000d.	279.6250	249s. 7½d.	35.00
6	91.375	79.875d.	279.7500	249s. 7½d.	35.00
7	91.375	79.750d.	279.7312	249s. 7¼d.	35.00
8	91.375	79.750d.	279.5937	249s. 9¼d.	35.00
9	(e)	(e)	(e)	(e)	35.00
11	91.375	79.750d.	279.6875	249s. 9½d.	35.00
12	91.375	79.750d.	279.5750	249s. 9d.	35.00
13	91.375	79.750d.	279.3125	249s. 8¾d.	35.00
14	91.375	79.750d.	279.3750	249s. 11¼d.	35.00
15	91.375	79.750d.	279.3750	249s. 10d.	35.00
16	(e)	(e)	(e)	(e)	35.00
18	91.375	79.750d.	278.9375	250s. 1¼d.	35.00
19	91.375	79.750d.	278.9875	250s. 3¼d.	35.00
20	91.375	79.625d.	278.9375	250s. 3d.	35.00
21	91.375	79.625d.	279.0625	250s. 3d.	35.00
22	91.375	79.625d.	279.1250	250s. 2d.	35.00
23	(e)	(e)	(e)	(e)	35.00
25	91.375	79.625d.	279.2187	250s. 1¼d.	35.00
26	91.375	79.625d.	279.0937	250s. 3¼d.	35.00
27	91.375	79.625d.	279.0625	250s. 4d.	35.00
28	91.375	79.625d.	278.9062	250s. 4½d.	35.00
29	91.375	79.625d.	278.7656	250s. 6d.	35.00
30	(e)	(e)	(e)	(e)	35.00
AVERAGES FOR MONTH					
Mar.	91.375	79.744d.	279.305	—	35.00
AVERAGES FOR WEEK					
Mar.					
6	91.375	—	279.679	—	35.00
13	91.375	—	279.580	—	35.00
20	91.375	—	279.123	—	35.00
27	91.375	—	279.112	—	35.00

Calendar Week Averages: New York Silver: March 2nd, 91.375; 9th, 91.375; 16th, 91.375; 23rd, 91.375; 30th, 91.375.

(e) No Market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.400c per pound, the average differential for delivery charges.

(b) Our export quotations for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.125c for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West effective Jan. 1, 1951, commanded a premium of 1.35c per pound over the current market for Prime Western; Special High Grade 1.75c effective Dec. 1, 1955.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 pounds.

(c) The daily silver quotation reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually one quarter cent below the price at which such offers are made.

The Treasury's purchase price of newly minded domestic silver is 90.5 per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U.S. Treasury's gold price,. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34,9125.

London Metal Exchange Quotations

Mar.	COPPER Cash Bid	COPPER Cash Asked	COPPER 3 Mo. Bid	COPPER 3 Mo. Asked	LEAD Current Month Bid	LEAD Current Month Asked	LEAD 3 Mo. Bid	LEAD 3 Mo. Asked	ZINC Current Month Bid	ZINC Current Month Asked	ZINC 3 Mo. Bid	ZINC 3 Mo. Asked	TIN Cash Bid	TIN Cash Asked	TIN 3 Mo. Bid	TIN 3 Mo. Asked
1	243	243½	241½	242	112	112¼	111¾	112	96¾	97¼	94¾	95	763	763½	749	750
4	243	243½	241	241½	112½	112¾	112¼	112½	97	97¼	95	95¼	773	774	754	755
5	243	243½	241	241½	113	113¼	112½	112¾	97	97½	95	95¼	768	769	751	752
6	243	243¼	241¼	241½	113	113¼	112½	112¾	97½	97¾	95¼	95½	764	765	749	750
7	241	241½	239½	240	113½	114	112¾	113	98	98¼	95¾	96	764	765	747	748
8	241	241½	239½	240	113¾	114	113	113¼	97½	98	95¼	95½	765	766	748	749
11	238½	239	237½	238	113¼	113½	112¼	112½	97	97¼	94¾	95	758	759	744	745
12	239½	240	239	239½	113¼	113½	112¼	112½	97	97¼	95	95½	761	763	747½	748½
13	240¼	240½	239½	239¾	113¼	113½	112½	112¾	96¾	97	95	95¼	764	765	747	748
14	238½	239	238	238½	113	113¼	112¾	112½	95½	95¾	94½	94¾	763	765	747	748
15	239¼	239½	238½	238¾	113¼	113½	112¾	112½	95½	96	94½	94¾	773	774	757	758
18	237½	237¾	237½	237¾	113	113¼	112	112¼	95¼	95½	94	94¼	767	768	751	752
19	237	237¼	237¼	237½	113¼	113½	112¼	112½	95½	95¾	94¼	94½	763	765	751	752
20	236½	236¾	237	237½	113	113¼	112	112¼	95	95¼	93¾	94	766	767	756	756½
21	235¾	236	236	236¼	113	113¼	112	112¼	95¼	95¾	94	94½	771	772	761	762
22	235½	235¾	236¼	236½	113¼	113½	112¼	112½	96	96¼	94½	94¾	769	770	756	757
25	237	237½	237¾	238	113	113½	112¼	112½	96¼	96½	94½	94¾	791	793	778	779
26	237½	237¾	238¼	238½	112¾	113	112	112¼	96¼	96½	94½	94¾	789	790	775	776
27	239½	239¾	240¼	240½	112¾	113	112	112¼	96	96½	94¼	94¾	782	784	771½	772
28	239½	239¾	240	240½	112½	112¾	111¾	112	96½	96¾	94½	94¾	780	782	769	769½
29	241	241¼	241½	241¾	112	112½	111¾	112¼	98	98¼	94½	95	778	779	766½	767
Av'g's	£239.548		£239.137		£113.104		£112.345		£96.613		£94.789		£770.726		£756.429	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.97%, zinc 98¾ and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments f.o.b. New York unless otherwise stated, tons of 2,000 lb. unless otherwise noted. St—short ton; lt—long ton.

MISCELLANEOUS METALS

Mar. 30, 1957

Aluminum ingot, 99 plus % lb.			27.1¢
Antimony, spot, lb. less than carload, in cases			36.59¢
In bulk, carload lots, f.o.b. Laredo			33.00¢
Bismuth, ton lots, lb.			$2.25
Cadmium, commercial sticks, delivered, lb.			$1.70
Calcium, lb. ton lots, 98%, cast			$2.05
Chromium, 97% grade, lb. contract del.			$1.29
Cobalt, 97 to 99%, per lb. eff. Feb. 1, 1957			$2.00
Germanium, per gram, 10,000 gram lots	44½¢	@	48½¢
Indium, troy oz.			$2.25
Lithium, lb. 98%	$11.00	@	$14.00
Nickel, cathodes, lb. f.o.b. Port Colborne (a)			74¢
Other sales, reg. sellers	88½¢	@	$1.345
Sales by dealers, etc.			$2.15
Magnesium, 99.8% carloads, lb. producer's plants, Velasco, Texas, eff. Apr. 16			35¼¢
Palladium, troy oz.	$23.00	@	$24.00
Platinum (wholesale lots), troy oz.	$92	@	$95
Quicksilver, flask of 76 lb., 25 flasks or more	$255	@	$257
Selenium, 99 plus %, lb. (Feb. 1) (c)			$12
Silicon, minimum 97%, carloads, lb.			20½¢
Semi-Conductor grade, lb.			$3.50
Tellurium, lb.			$1.65
Thallium, 100 lb. or more, lb.			$12.50
Titanium, 99.3 plus, grade A-1, max. 3% iron, lb.			(b)$2.75

(a) Eff. Dec. 6, 1956; incl. U. S. duty; (b) Effective Dec. 3, '56. (c) Jan. 1, '57 the $15.50 will drop to $12; the "producer" price, now $13.50, will be discontinued.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per short ton unit	$36.00	@	$37.00
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:			
44% Cr_2O_3 no ratio	$30	@	$30.50
48% Cr_2O_3 3 to 1 ratio	$55	@	$61
Iron Ore, Lake Superior, Lower Lake ports, long ton:			
Old Range bessemer			$11.85(e)
Mesabi bessemer			$11.60(e)
Mesabi, non-bessemer			$11.45(e)
Lead (Galena), 80%, Joplin, Mo., ton			$201.32
Manganese Ore—Per long ton unit of Mn basis 48% manganese, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports, import duty extra, export duty included, $1.64 @ $1.67; both duties excluded, $1.505 @ $1.535. Long-term contract nominal.			
Molybdenum Ore, 90%, per lb. of Mo f.o.b. mines	$1.18	@	$1.23
Columbium-Tantalum, per lb., combined oxides 10 to 1 ratio	$1.35	@	$1.40
Tungsten Ore, per unit of WO_3:			
Foreign 60%, c.i.f. U. S. ports, duty extra	$20.00	@	$20.75
U. S. mined concentrate, per stu, f.o.b. mill (GSA price) (Suspended)			$55
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines			31¢
Zinc Ore, Prime, 60% concentrate, Joplin, Mo., per ton			$84.00

(a) Nominal. (e) Eff. 1957 shipping season.

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb., in bbl carload lots delivered			5½¢
Cobalt Oxide, 72½% to 73½%, per lb. eff. Dec. 1, '56	$1.52	@	$1.55
Copper Sulphate, 100 lb. eff. Oct. 25, '56			$13.90
Germanium Oxide, gram			27½¢
Molybdic trioxide, technical, per lb of Mo	$1.38	@	$1.41

ALLOYS

Ferrochrome 65 to 70%, per lb. of Cr. (4-9% C)			27¾¢
Ferromanganese, 74 to 76%, per lb., shipg. pt.			12¾¢
Ferromolybdenum, 58 to 64% Mo, lb. of Mo contained	$1.68	@	$1.74
Ferrosilicon, 50% per lb. of Si f.o.b. shipping point (3-19-57)			13¢
Ferrotungsten, 72 to 82%, lb. of W contained			$2.95
Ferrovanadium, per lb. of V delivered	$3.20	@	$3.40
Silicomanganese, max. 1½% carbon, lb., contracts			12.8¢
Spiegeleisen, per long ton, 19 @ 21% grade eff. Jan. 7			$102.50

NON-METALLIC MINERALS

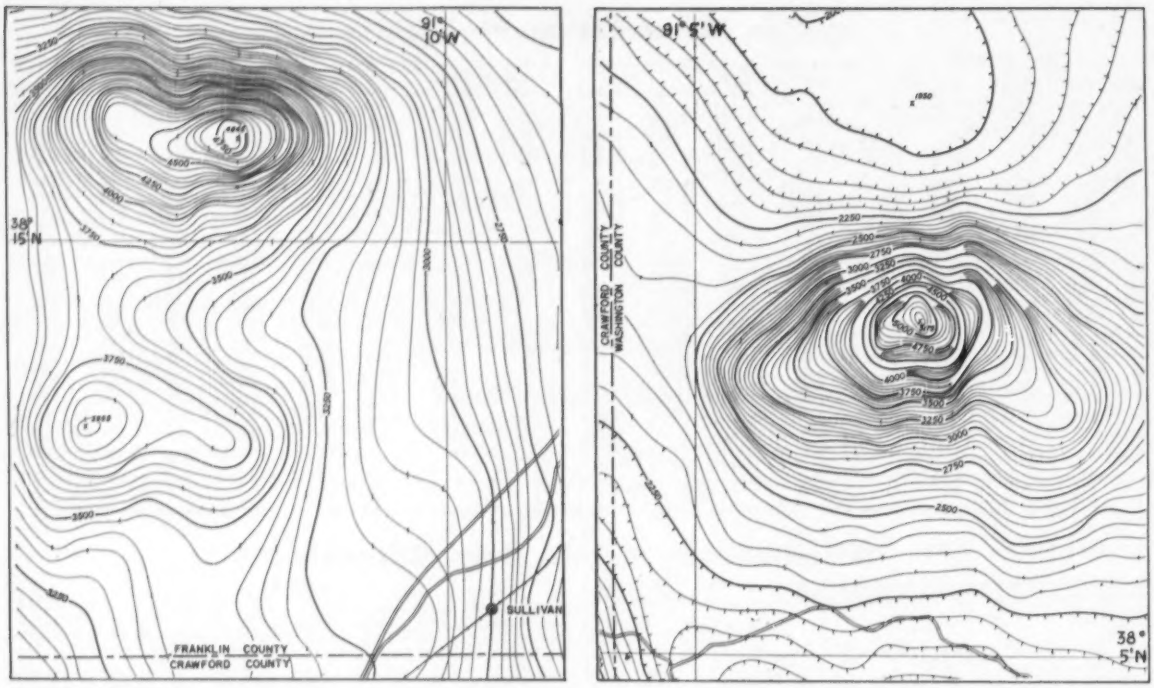
Asbestos, f.o.b. Canada (Quebec) mines (U. S. funds) ton:			
Crude No. 1	$1,400	@	$1,725
Crude No. 2	$750	@	$1,100
Spinning fibers	$350	@	$650
Shingle fibers	$190	@	$210
Paper stock	$114	@	$137
Waste	$82	@	$84
Shorts	$28	@	$75
Asbestos, f.o.b., Vancouver, B. C. (U. S. funds):			
Spinning fibers	$470	@	$750
Shingle fibers, effective Jan. 1	$210	@	$310
Asbestos, Vermont, f.o.b. Hyde Park:			
Spinning fibers	$353	@	$383
Shingle stock	$172	@	$190
Paper stock	$114	@	$145
Waste, stucco or plaster			$82
Refuse or Shorts	$39	@	$72
Barytes f.o.b. cars:			
Georgia, crude, per ton			$18
Missouri, 94% $BaSO_4$, per short ton			$16
Crude oil well grade, min. 4.3% sp. gravity, st (a)			$11.50
Imported, c.i.f. Gulf Ports, st	$16	@	$18
Bauxite, long ton, f.o.b. point of shipment:			
Domestic, crude, 50 to 52% (not dried) (a)	$ 5.00	@	$5.50
Domestic, chemical, 55 to 58% (a)	$ 8.50	@	$9.05
Domestic, abrasive, 80 to 84% (a)	$18.00	@	$18.50
Imported metallurgical, per lt, f.o.b. Br. Guiana, dep. on grade			$7.14
Feldspar, bulk ton:			
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50	@	$22.25
Glass feldspar, white, 20 mesh	$11.75	@	$12.50
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37	@	$41
60% effective CaF_2	$33	@	$36.50
Acid 97% concentrate, bulk, ton: contract			$52.50
spot			$55
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00	@	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$40.00
Mica—Domestic, f.o.b. mines. Punch 7¢ to 12¢ per lb. according to size and quality. Sheet clear, 1½ x 2-inch, 70¢ to $1.10; 2 x 2-inch, $1.10 to $1.60; 2 x 3-inch, $1.60 @ $2.10; 3 x 3-inch, $1.80 @ $2.30; 3 x 4-inch, $2.00 @ $2.60; 3 x 5-inch, $2.60 @ $3.00; 4 x 6-inch, $2.75 @ $4.00; 6 x 8-inch, $4.00 @ $8.00. Wet ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground: $32.50 @ $70.00 per ton. Scrap, $25 and up.			
Ocher, Georgia, ton, in sacks	$26.50	@	$30.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports			Not quoted
Sulphur, per lt, f.o.b. U. S. mines: bright			$26.50
dark			$25.50
Mexican, per lt, f.o.b. mines, dark, 280 pesos			$22.40
Talc, f.o.b. works, ton:			
New York, purified	$18.50	@	$20.00
Vermont, extra white			$12.50
Tripoli, Missouri, ton:			
40-mesh, cream colored			$50.00

(a) Nominal. (b) Corrected.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces			$64.50
Steel, f.o.b. Pittsburgh, billets, net ton			$74.00
Structural shapes, Pa., Ala., etc., 100 lb.	$4.85	@	$5.00

THIS MONTH IN MINING



DETAIL FROM USGS MAP GP 78 of a 1950 aeromagnetic survey by W. J. Dempsey and J. L. Meuschke, shows anomalies in the area where St. Joe and Bethlehem made their iron finds. Anomaly at right is approximately at Pea Ridge.

St. Joe, Bethlehem Study Missouri Iron Find

A JOINT VENTURE to develop a large iron ore deposit in east central Missouri is being studied by St. Joseph Lead Co. and Bethlehem Steel Corp. The deposit is one of three discovered in the area 40 miles northwest of Bonne Terre by aeromagnetic survey in 1950-1951. While no announcement of reserves is available, it is estimated that they range from 50- to 100-million tons.

St. Joe president Andrew Fletcher, in a statement to stockholders, noted that the two firms are "actively studying (the) proposal on the basis of an annual output of 2-million tons." The ore is magnetite, and will require beneficiation to separate and remove apatite. Product will be pelletized for blast furnace charging.

The main find, called the Pea Ridge, has been drilled, according to Fletcher, "sufficiently to indicate the probability of a very large tonnage of commercial grade iron ore at a depth between 1400 and 3,000 ft. . . . The other two bodies in the same general area have been drilled less extensively, but are considered as of definite interest."

The statement, which was released by the St. Joe management "to prevent possible distortion of facts," discusses the joint operation as follows:

"Bethlehem Steel approached us with a proposal to form a joint 50-50 company to exploit the Pea Ridge deposit. Under the suggested arrangement, St. Joe would take the major responsibility of operating the mine and Bethlehem would supply the major financing, their knowledge of iron ore beneficiation, and a market for the product.

"Five years of construction and mine preparation would probably be necessary for such a large-scale enterprise before reaching the production stage. The value to St. Joe, and to Missouri, of another large-scale center of mining near the spot where we have worked for 93 years, is obvious."

Exploration in Missouri is also underway by American Zinc, Lead and Smelting Co. in a joint venture with Granite City Steel Co. under an agreement which "contemplates the development of mining properties for the use of both companies in the event that any commercial ore discoveries are made." Two firms will share expenses of exploration and development with operation of any given property in the hands of American Zinc.

Prospectors and Developers Note 25 Years

PROSPECTORS, engineers, geologists, and mining men from all over Canada and the U. S. met in Toronto early last month to celebrate the Silver Jubilee of the Prospectors & Developers Association. The 3-day convention was the largest in the history of the association.

More than a score of experts in various fields of the mining industry spoke at well-attended technical sessions, a regular feature of the convention. Speeches covered a wide range of subjects, including exploration, geophysical and geochemical prospecting, geology, and new discoveries. Various problems relating to the prospector and the industry were also dealt with.

At the business session, Viola R. MacMillan was elected to her 14th consecutive term as president. Cyril T. Young was re-elected vice president. G. Miller was appointed secretary, succeeding F. H. Jowsey, while Mrs. D. I. Drewe was again returned as assistant secretary. New members of the executive are as follows: D. Kemp, K. Springer, H. Kenty, H. Dixon and R. Martin. Retiring members included W. Blair, J. P. Dolan, A. Mosher, M. Shunsby and W. J. Wiltsey. Five of the original founders, E. Cochenour, F. McLeod, T. H. Rea, E. Rutherford and K. Springer, were made honorary members.

A complete program of entertainment and social functions rounded out the well-organized convention. A special program was also arranged for the ladies. The proceedings were terminated by the traditional banquet (see p 122).

McGill Offers New Degree

DEPARTMENT OF GEOLOGICAL SCIENCES, McGill University, is offering a new two-year sequence of courses leading to a degree of Master of Science (Applied) in Mineral Exploration. New techniques and discoveries will be emphasized, with side journeys into the legal and financial aspects of exploration.

Mining Calendar

23rd Annual Engineers' Day, Colorado School of Mines, Golden, Colo. April 12-13.

Pacific Northwest regional conference, AIME. Multnomah Hotel, Portland, Ore. April 11-13

Second Annual Symposium on Rock Mechanics, Colorado School of Mines Department of Mining Engineering. Golden, Colo. April 21-24

Eighth Annual Symposium on Spectroscopy, American Association of Spectrographers, Hotel La Salle, Chicago, Ill. April 29-May 1

Institute on Lake Superior Geology, Michigan State University. East Lansing, Mich. May 6-8

Geological Society of America, Southeastern section, Morgantown, W. Va. May 16-18

Uranium Institute of America annual meeting and mill symposium. Denver, Colo. May 17-18

33rd Annual Conference, Lake Superior Mines Safety Council. Duluth, Minn. May 23-24

Spring Meeting, Central Appalachian Section, AIME. Maple Shade Inn, Pulaski, Va. May 24-25

Second Reactive Metals Conference, Southern California section, AIME, Los Angeles, Calif. May 28-29

Idaho Mining Assn. Sun Valley, Idaho. July 15-16

Aluminum Metal Plant Set for Surinam Site

A LETTER OF INTENT has been signed with the Government of Surinam by Aluminum Co. of America, under which a major hydroelectric power project and construction of a $45-million aluminum metal producing plant will be undertaken.

Under the "Brokopondo Plan," Surinam will finance the dam, powerhouse and transmission lines and Alcoa will build and operate a 60,000-ton per year smelter, the first such in South America.

Uranium Ores "Ample"

JESSE C. JOHNSON, director of the division of raw materials, AEC, told a Congressional committee last month that AEC was "gradually bringing its program of uranium production and its purchases of ore into balance" so that it did not expect either a surplus or a shortage in the next decade. "We are in a strong position, competitively, costwise and from the standpoint, I think, of total reserves," he said.

As We Went to Press . . .

Cape Smith area of Northern Ungava is the site of one of the largest mining rushes in Quebec history, according to Premier Maurice Duplessis. Some 32 firms have received permits to explore the nickel-copper area between the Cape and Hudson Strait, and have promised to conduct exploration work for three years, expending $1,000 annually on each square mile under exploration.

American Smelting & Refining Co., through its wholly-owned subsidiary Asarco Nickel Co., Ltd., has negotiated an agreement with eight other companies headed by Little Long Lac Gold Mines to explore one large concession held by LeMoyne Ungava Mines Ltd. Under the agreement, Asarco will take over the concessions, provide the necessary money for exploration, and, if warranted, place the property in production.

Gov. Edwin L. Mechem of New Mexico has signed a legislative measure increasing the severance tax on uranium to one half of one per cent. Effective immediately under an emergency clause, the new legislation replaces a one-eighth of one per cent tax.

First purchase of uranium concentrate from a mine in New York State may be forthcoming following agreement between AEC and Ramapo Uranium Corp., which specifies purchase (at $8 per lb) of concentrates produced by the company at its pilot plant at Warwick, N. Y.

AEC agrees to purchase a maximum of 50,000 lb U_3O_8 when the pilot plant begins shipping.

Cerro de Pasco's activity in the field of hydroelectric projects may continue beyond Paucartambo (see p 75). Company has confirmed that it is studying the establishment of an alumina reduction works in conjunction with another water project. Robert P. Koenig, Cerro president, said, "The combined plan for a power plant with ultimate potential of 750,000 kw at Mantaro Bend, coupled with an aluminum plant near the Bay of Paracas, is a long-term one in the early stages of investigation. . . . Alumina would be imported from outside sources." Hydro development alone might cost $200-million.

Cord mine, in Utah's Big Indian district has been sold to Jen, Inc., of Salt Lake, for a reported $17-million. The properties contain an estimated 500,000 tons of uranium ore with uranium oxide values ranging about 0.7%. Chairman of the purchasing firm is E. H. Snyder, president of Combined Metals Reduction Co. and a director of Uranium Reduction Co., which operates a mill at Moab. Original owners included E. L. Cord, Nevada state senator and former maker of the Cord automobile. President of the purchasing firm is C. E. Tuttle, businessman and financier and regent of the University of Maryland.

Extensive prospecting activity in several counties in North and South Carolina continues behind a veil of secrecy. Piedmont Properties, one of the leading participants, is, according to Thomas A. Evins, a vice president, " . . . still going on. We are continuing along the same lines as when we started last summer. We cannot make a public announcement now regarding our progress."

Kaiser Aluminum & Chemical Corp. are also active in the area, admitting that they are interested in aluminum sources. Piedmont will not say what mineral is sought, and speculation runs from lithium through beryl to bauxite.

Behind the By-Lines...

G. P. Lutjen

On hand in March, when Cerro de Pasco, in the person of President Robert Koenig, turned on the spigot at Cerro's new Paucartambo hydroelectric project, was our Mr. Knoerr. First dam opening he's ever been to. It's an important one, because it will give Cerro year-round power for present and expanded operations. The Editor's on the spot report starts on p 96.

Sound philosophy cropped up in one of the national magazines devoted to cultural pursuits. The subject was poker-playing and how to increase one's financial well-being thereby. The philosophy: "Those who whine about hard-hearted tactics are pigeons, no better. You can listen to their complaints as you count their money. It is better to play with hard losers than any kind of winner."

While we rest our tired blood (after its coursing around in New Orleans: see p 100) we are turning the rest of this space over to some friendly contributors. Thank you, gentlemen, and as they say in New Orleans, "You-all come back."

We suspect the first item comes from a prominent waterskier at an upstate New York lead mine. It was clipped from a W. S. Tyler Co. publication.

"Sometimes you run across a simple, brilliant way of describing something complicated. A fine example, which may be old to engineers, is a method of describing the four stages in the operation of a four-stroke cycle engine.

"The usual description is: intake, compression, ignition, exhaust. That is, a cylinder in the engine takes in a mixture of gasoline and air, then compresses it to a small volume. At this point the mixture is set off by the spark plug, and the explosion drives the cylinder back. Then the burned-out gases are expelled, leaving the cylinder ready for a fresh fuel mixture again.

"From a boy's book called *The Story of Power*, by Edward Stoddard, we learned a simpler way of describing the cycle: suck, squeeze, pop, phooey."

Mr. R. E. Whitson Jr., sales manager of the fast-growing Kyanite Mining Corp. of Cullen, Va., forwarded the following scientific data:

Chemical Specifications of that Little-Known Element—Woman

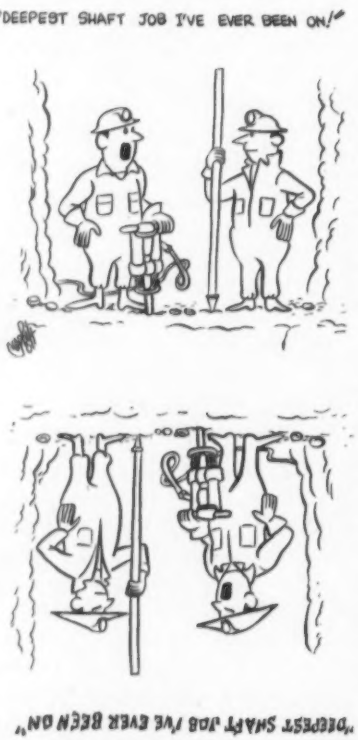
Symbol: Wo (or sometimes "Ah!")
Accepted Atomic Weight: 120
Physical Properties: Boils at nothing and freezes at any minute. Melts when properly treated, very bitter if not well used.
Occurrence: Found wherever man exists.
Chemical Properties: Possesses great affinity for gold, silver, platinum and precious stones. Violent reactions if left alone. Turns green when placed beside a better looking specimen.
Uses: Highly ornamental, useful as a tonic in acceleration of low spirits and an equalizer of distribution of wealth. Probably the most effective income-reducing agent known.
Caution: Highly explosive in inexperienced hands.

Our Better-Signs-for-Home-and-Plant Department also received an anonymous helping hand.

Sign in a tavern: "By special arrangement with the First National Bank, we do not cash checks and they do not sell beer."

Attention would-be witch doctors: An AP dispatch from Washington reports, "Distributors of a do-it-yourself voodoo kit have promised the Post Office Department not to offer the kit by mail."

This voodoo-it-yourself deal sounds almost as intriguing as the new offer we read on the back of the cereal box a while back. It began, "Be the first one on your street to rule the world."



And before we fold our tents and silently steal away, we had better give the answer to the little problem we posed last month. In essence we have 100 bags each containing 100 one-ounce gold coins. One bag turns out to be 10% overweight or underweight. Since it contains 100 coins, each coin is 10% over—or underweight. The problem: To determine in one weighing on a sensitive scale which bag is over or under.

The solution: Line up the bags and then take one coin from the first bag, two coins from the second, three from the third and so on to 99 coins from the 99th bag and 100 coins from the last bag. If all coins were exactly one ounce, the total weight would be exactly 5,050 oz. If the off-weight bag were the first bag sampled (one coin) the total weight would be over or under by 0.1 oz. If the off-weight bag were the 85th, the total weight would be off by 8.5 oz. Thus you can easily spot the offending sack in one weighing.

That wasn't so difficult, was it? We'll try to find a tougher one for next month.

Vertical Casting Wheel Now in Full Production at Utah Copper Refinery

It's Almost "Push-Button" Casting—

Here's How it Works

AUTOMATIC VERTICAL CASTING of cakes up to 3200 lb in weight is now an accomplished fact at the Utah refinery of Kennecott Copper Corp. at Garfield, Utah. It is the outgrowth of a $2½-million construction and expansion program launched in 1954. Key unit of the new plant is a vertical casting wheel incorporating in its design, special features recommended by Kennecott engineers and operating personnel. It is unique in several major respects as compared with similar units in operation elsewhere.

Outstanding design features include:

(1) Provision for synchronized positioning of water-cooled molds, permitting production either of vertically cast billets, both electro-copper and phosphor deoxidized, in a limited range or composition, or of vertical cast cakes in both tough-pitch and silver-bearing, tough-pitch copper.

(2) Use of the most modern equipment and techniques in the application of synchronized automation in pouring, dumping and conveying of the copper shapes produced.

(3) The wheel is designed and arranged so that a reasonably rapid transfer from one shape to another can be effected.

(4) A spray cooling chamber is provided instead of the conventional bosh for immersion and quenching, resulting in faster and more efficient cooling of the large mass of vertically cast cakes.

(5) An elaborate fume control system to insure good working conditions on and around the wheel, particularly during casting of billets. A mixture of graphite and oil is used for cleaning and spraying molds prior to filling with molten copper with consequent production of dense fumes. Intakes have been installed at strategic points with branch ducts connected to main duct leading to the fume collecting plant outside the casting building.

The exacting requirements of mold positioning, particularly in the case of billets, are accomplished automatically by numerous limit switches, with manual controls provided for emergency operation.

Casting Wheel Design

The wheel proper is 37 ft in diameter and installation required an excavation of some 40 ft below the main casting floor. Rotation is accomplished through a ring-gear drive actuated by an hydraulic motor-pump unit. As built the wheel provides for 14 pouring positions, two cake molds in each position, except for only one of the largest sizes, and for setting of 28 double-cavity billet molds, with 4 billets cast simultaneously in each position.

Molten refined copper is discharged from two electric are furnaces equipped with 6,000-kva, 13,800v transformers with 12 secondary taps ranging from 85 to 225v at the rate of 40 tph. It is delivered to the pouring ladle serving the vertical casting wheel via an extension of the existing launder system used in conjunction with the regular wire bar casting wheels. Intermediate holding furnaces have not proved necessary.

One operator in a centrally situated booth or cab a short distance above the wheel floor controls the pouring ladle and start of the rotary movement of the wheel. He regulates by remote control to multi-lipped ladle movement in such a manner as to provide for delivery of two streams of molten copper into the two cake molds or four streams into four billet molds in an evenly distributed mass through a ladle leveling device to produce cakes or billets of uniform size. The wheel is advanced a step at a time, the movement being synchronized with dumping, cooling and elevating operations.

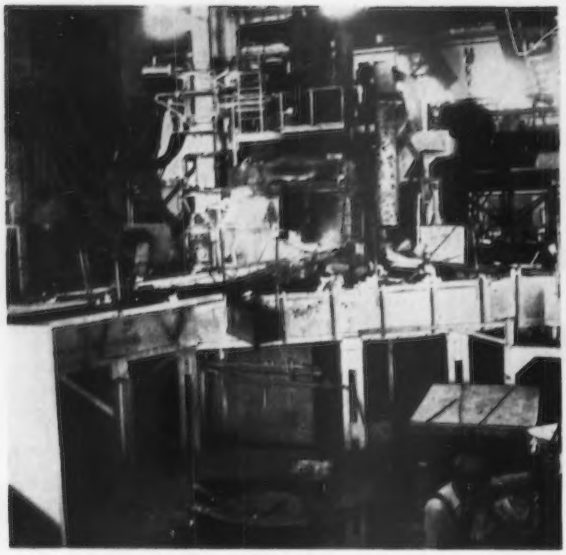
Prior to pouring cakes, a "tear drop" shaped band of thin sheet copper is positioned in the bottom of each mold to restrict splash of molten copper. About 3½ min are required to pour two rectangular 3200-lb cakes, each measuring 7x25x72 in.

Cake Dumping

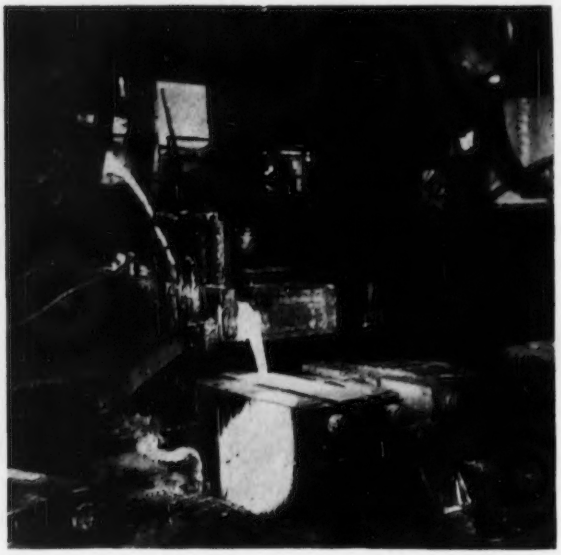
Each mold is automatically relieved of its pour as it stops at a position central to the counter-balanced cake-dumping device below. This unit is designed to transfer the freed cakes or billets to the steel conveyor leading to the spray cooling chamber. The cakes have a minimum free fall travel after the dumper platen arms disengage the mold door bail, permitting the hinged bottom door to swing away freely.

The dumper then lowers the cakes on hydraulic pistons, turns them 90

To see how the vertical casting wheel works, turn the page.

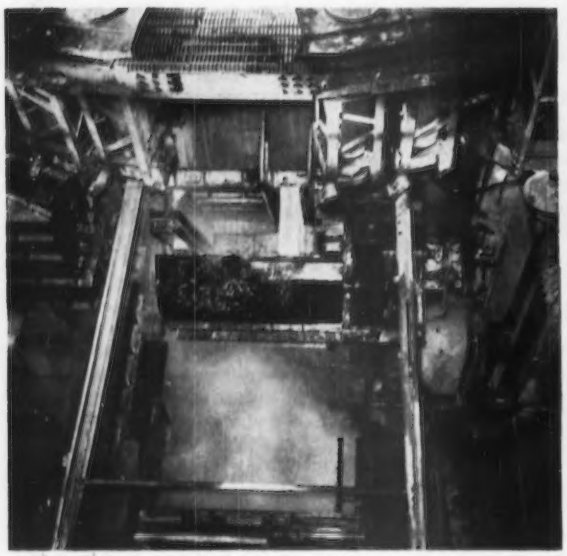


1 **ELECTRIC ARC FURNACE.** Two of these units deliver 40 tph of molten refined copper to wheel via launder.

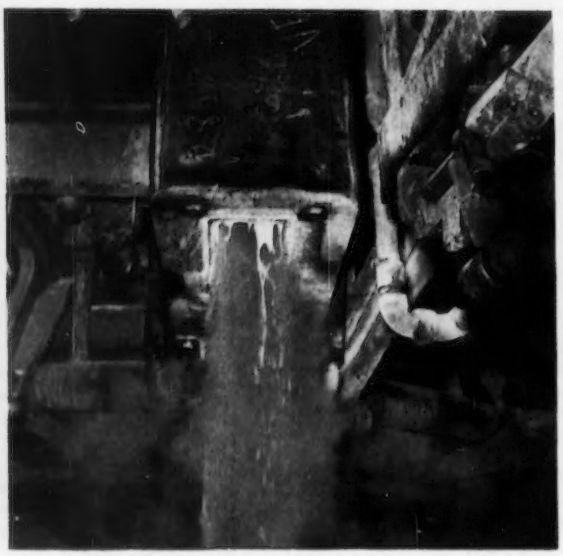


2 **POURING LADLE,** regulated by remote control, pours from ladle into mold producing 3200-lb cakes.

How the Vertical Casting Wheel Operates



5 **LOADED CAKE DUMPER** is starting the 90-deg rotation to deliver the cake to edge of spray cooling chamber.



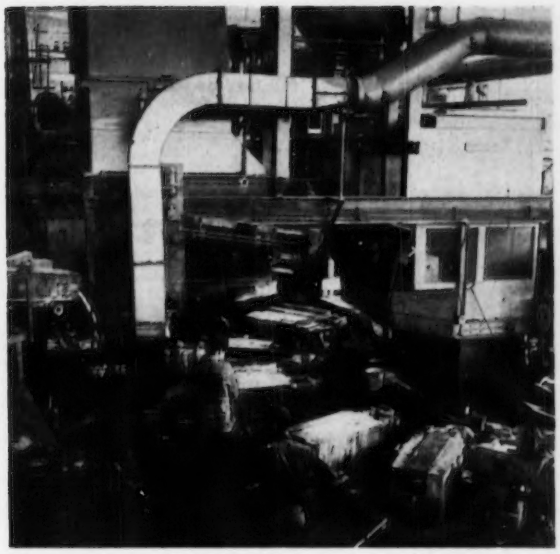
6 **EMPTY CAKE MOLD** is automatically sprayed with bone ash prior to reset of hinged bottom and return to ladle.

deg to a horizontal position and delivers them on edge to the spray chamber conveyor. After removal of cast shapes, coating of cake molds with bone ash and cleaning and coating of billet molds with the graphite and oil mixture mentioned previously is done automatically with special spray arrangements.

After treatment in the spray cooling chamber the cakes and billets are elevated to the main plant floor by a steeply inclined steel conveyor. Cakes are delivered to the steel inspection conveyor ahead of the counter-balanced cake turn-over unit by means of a transfer chain and piston. On this conveyor the operator inspects the upper side of the cake and if required does cleaning or chipping of surface defects.

Transfer of the cake to the second inspection conveyor to permit inspection of the lower side of the cake is accomplished by moving the cake into the hold of the cake turn-over unit, then turning it 180 deg, and removing the cake from the hold onto the conveyor. All of these motions are automatic. In the inspection area are also available a cut-off saw and cupping attachment for production of finished billets.

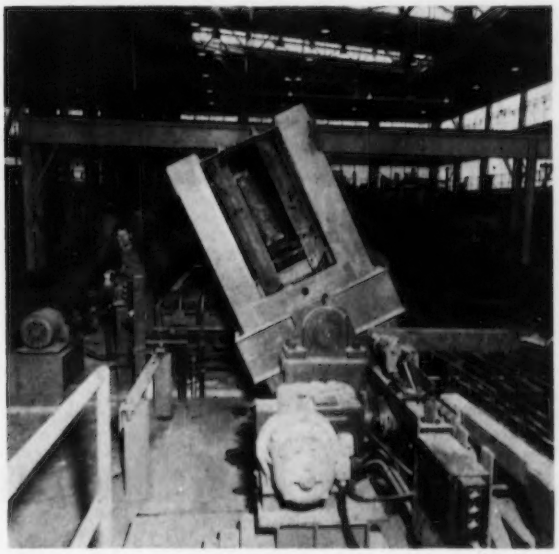
To provide self-containment in the operation of the vertical casting wheel and fabricate large-size, water-jacketed cake molds, there have been installed at the refinery two special and expensive machines—namely, a horizontal



3 **FILLED CAKE MOLDS** are advanced in steps to position lining up with counter-balanced cake dumping device.

4 **HYDRAULIC PISTONS** lower cake, freed from mold, onto cake dumper for transfer to spray cooling chamber.

to Cut Costs and Improve Product



7 **CAKE TURN-OVER UNIT** turns cake over and places on second conveyor for inspection of top side of cake.

8 **OPERATOR CHIPS OFF** defects on upper side of cake removed from turn-over unit onto inspection conveyor.

boring mill and large draw-out shaper. Refinery engineering personnel has designed and is using a sectioned cast-iron "mother mold" in which the cake molds proper are cast of copper.

Cooling System

The molds on the wheel are cooled by water circulating within the mold walls, a revolving seal arrangement being used to accomplish this while the wheel is in motion. To overcome any problems created by impurity content of water from available sources, a closed water system for cooling the molds is used. The water is treated to maintain requisite levels of purity, and its temperature is controlled by passing through heat exchangers. The external cooling water is circulated through a conventional cooling tower.

With the installation described, the refinery is now in a position to furnish Kennecott's customers with a nearly complete and diversified range of vertical cast shapes greatly in demand by industry. For the present, production of 3- and 4-in. diameter billets 52 in. long and cakes ranging in length up to 72 in. and weight up to 4,000 lb are planned. As has previously been the case in refining and casting at the Utah refinery, a comparatively small group of experienced operators are again proving successful in training inexperienced personnel in the performance of the exacting casting techniques currently required.

Bit Costs Were Cut 1/3 With Smaller Bits

Timken "M" Series, Bits

Month	Footage drilled	New bits issued: MC 1¼-in.	MCD 1⅝-in.	MCD 1¾-in.	Total	Avg cost per bit	Avg feet per bit	Avg cost per foot
1954								
May	26,611	128	114	4	246	$11.56	108	$0.107
June	31,452	99	120	68	287	11.88	110	0.108
July	17,582	47	48	36	131	11.89	134	0.089
Aug.	17,051	48	36	24	108	11.76	158	0.074
Sept.	21,033	54	42	30	126	11.79	167	0.071
Oct.	18,787	28	34	22	84	12.68	224	0.057
Nov.	14,781	51	33	27	111	12.55	133	0.094
Dec.	23,197	68	56	28	152	12.53	153	0.082
Total 1954	170,494	523	483	239	1,245	$11.99	**137**	**$0.088**
1955								
Jan.	16,328	49	39	37	125	$12.64	131	$0.096
Feb.	14,414	41	33	6	80	12.40	180	0.069
Mar.	10,653	19	21	20	60	12.73	178	0.072
Apr.	2,806	3	2	3	8	12.70	351	0.036
May	1,090	12	16		28	12.44	39	0.319
June	4,721	16	12	4	32	12.44	148	0.084
July	6,585	15	12		27	12.32	227	0.051
Aug.			2		2	12.85		
Total 1955	56,597	155	137	70	362	$12.55	**156**	**$0.080**
1956								
Jan.	2,719							
Feb.	10,559	6	47	6	59	$12.81	179	$0.072
Mar.	6,966		48		48	13.92	145	0.096
Apr.	3,165	12	12		24	12.91	132	0.098
May	4,125	12	24		36	13.25	115	0.115
June	2,550		24		24	13.92	106	0.131
July	3,155		36		36	13.92	88	0.158
Total 9 mos 1956	33,239	30	191	6	227	$13.42	**146**	**$0.092**

Timken "F" Series Bits

Month	Footage drilled	New bits issued: FCA 1⅜-in.	FCA 1½-in.	FCA 1⅝-in.	Total	Avg cost per bit	Avg feet per bit	Avg cost per foot
1954								
May	20,804	52	45		97	$10.17	214	$0.048
June	19,319	42	54	15	111	10.57	174	0.061
July	33,851	82	158	10	250	10.53	135	0.078
Aug.	36,113	42	226	44	312	10.95	116	0.094
Sept.	54,148	54	139	36	229	10.82	236	0.046
Oct.	38,060	36	76	16	128	11.60	297	0.039
Nov.	43,877	54	138	12	204	11.56	215	0.054
Dec.	41,961	36	130	12	178	11.66	236	0.049
Total 1954	288,133	398	966	145	1,509	$11.00	**191**	**$0.058**
1955								
Jan.	39,483	33	163	10	206	$11.71	192	$0.061
Feb.	31,991	59	171	16	246	11.60	130	0.089
Mar.	44,766	21	148	8	177	11.76	253	0.046
Apr.	40,359	37	133	12	182	11.66	222	0.053
May	32,334		107		107	11.90	302	0.039
June	34,117		79	8	87	11.99	392	0.031
July	40,693		151	8	159	11.95	256	0.047
Aug.	38,963		147	4	151	11.93	258	0.046
Sept.	38,801		133	21	154	12.03	252	0.048
Oct.	45,167		163	14	177	11.98	255	0.047
Nov.	35,718		130		130	11.90	275	0.043
Dec.	41,660		141		141	11.90	295	0.040
Total 1955	464,052	150	1,666	101	1,917	$11.83	**242**	**$0.049**
1956								
Jan.	37,198		198		198	$11.90	188	$0.063
Feb.	29,550		102		102	11.90	290	0.041
Mar.	38,976		156	4	160	11.92	244	0.049
Apr.	48,172		162		162	11.90	297	0.040
May	47,283		256	2	258	12.85	183	0.070
June	35,294		150	1	151	12.85	234	0.055
July	27,751		212	1	213	12.85	130	0.099
Aug.	42,433		240		240	12.85	177	0.073
Sept.	26,810		168	1	169	12.85	159	0.080
Total 9 mos. 1956	333,467		1,644	9	1,653	$12.70	**202**	**$0.063**

ANNUAL FIGURES are considered the only significant ones since the month by month results vary widely. Reason for the monthly fluctuations lies in method of recording data. But method makes tabulation very easy by using information which is readily available from records already in general use.

These Easily Prepared Tables Were Used To Analyze Costs And Show In Part . . .

How the Getchell Mine Cut Underground

WILLIAM J. NEWMAN

SMALLER UNDERGROUND DRILLING EQUIPMENT has proven itself at Getchell. Reduction in bit costs, most closely studied phenomenon, is only one of a number of benefits. On the other hand, no real gain in drill steel costs can yet be claimed.

There were no drilling problems when the Getchell mine in the Potosi mining district of Humboldt County, Nev., centered operations exclusively in gold mining. The soft ore and waste for the most part were excavated from open pits by power shovel without drilling or blasting. The underground gold mine was under development, and the amount of drilling done was small.

Steel bits with an I-R Type 1 (bottom drive, reverse buttress, 1⅛-in. O.D.) thread were used both with wagon drills in the open pits and with conventional rock drills in underground development work. The steel repair shop serving both operations was equipped with a small electric furnace for forging and tempering the bits and threading and shanking of the drill steel, a grinder for sharpening the bits, and a small tank for tempering. One man did the steel repairs and sharpened the bits when necessary—only 3 or 4 days a month. But the situation changed materially after December 1950, with the switch to mining and milling tungsten ores occurring in the district.

Deposits under exploitation are principally tactite and were formed by an intrusive stock of granodiorite invading the sedimentary rock. This rock is a silicious limestone, altered to wollastonite in many places around the periphery of the granodiorite. At other points, argillite interbedded with the limestone has been altered to shale or hornfels. The tactite groundmass is a fine garnet with the typical associated metamorphic minerals of quartz, cal-

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Smaller Drill Steel Shows No Cost Advantage

"F" steel is ⅞-in. Hex.
"M" steel is 1-in. O-O & 1⅛-in. Rd.

Month	Footage drilled F	Footage drilled M	New steel cost F	New steel cost M	Cost of threading & shanking both new & used steel F	Cost of threading & shanking both new & used steel M	Cost in cents per foot hole drilled: New steel F	New steel M	New steel Avg	Thread and shank F	Thread and shank M	Thread and shank Avg	Total F	Total M	Total Avg
Jan. 1954...Total	—44,204		$492.67	$269.82	$540.00	$135.00			1.7c			1.5c			3.2c
Feb.....Total	—41,874		398.59	342.17	812.50	442.50			1.8			3.0			4.8
Mar.....Total	—46,482		245.10	171.56	345.00	120.00			0.9			1.0			1.9
Apr.....Total	—48,943		434.28	957.88	497.50	638.00			2.8			2.3			5.1
May.....20,804	26,611		84.18	505.75	432.50	479.50	0.4c	1.9c	1.3	2.1c	1.8c	1.9	2.5c	3.7c	3.2
June.....19,319	31,452		337.95	232.01	375.00	413.25	1.8	0.7	1.1	1.9	1.3	1.6	3.7	2.0	2.7
July.....33,851	17,582		524.66	116.01	930.50	452.50	1.6	0.6	1.2	2.7	2.6	2.7	4.3	3.2	3.9
Aug.....36,113	17,051		765.00	131.17	1136.25	380.25	2.1	0.8	1.7	3.2	2.2	2.9	5.3	3.0	4.5
Sept.....54,148	21,033		903.17	162.46	1618.75	113.50	1.7	0.8	1.4	3.0	0.5	2.3	4.7	1.3	3.7
Oct.....38,060	18,787		242.56	398.29	875.00	266.00	0.6	2.1	1.1	2.3	1.4	2.0	2.9	3.5	3.1
Nov.....43,877	14,781		717.14	466.73	1375.00	294.00	1.6	3.2	2.0	3.1	1.9	2.8	4.7	5.1	4.8
Dec.....41,961	23,197		655.55		1290.00		1.6		1.6	3.1		3.1			4.7
Total 1954	288,133	170,494	$5,800.85	$3,753.85	$10,228.00	$3,734.50	2.1c	2.2c	1.5c	3.5c	2.2c	2.2c	**5.6c**	**4.4c**	3.7c
Jan. 1955...39,483	16,328		$139.00	$108.51	$1077.50	$306.25	0.4c	0.7c	0.4c	2.7c	1.9c	2.5c	3.1c	2.6c	2.9c
Feb.....31,991	14,414		469.94		1185.00	87.50	1.5		1.5	3.7	0.6	2.7	5.2	0.6	3.8
Mar.....44,766	10,653		1319.05		1780.00		2.9			4.0			6.9		
Apr.....40,359	2,806		1056.31	157.94	1715.00	125.00	2.6	5.6	2.8	4.2	4.5	4.3	6.8	10.1	7.1
May.....32,334	1,090		643.32		1125.00		2.0			3.5			5.5		
June.....34,117	4,721		553.68	157.94	775.00	125.00	1.6	3.3	1.8	2.3	2.6	2.3	3.9	6.0	4.1
July.....40,693	6,585		274.20	197.42	750.00	250.00	0.7	3.0	1.0	1.8	3.8	2.1	2.5	6.8	3.1
Aug.....38,963			548.40		1000.00		1.4			2.6			4.0		
Sept.....38,801			464.03		1000.00		1.2			2.6			3.8		
Oct.....45,167			558.95		1000.00		1.2			2.2			3.4		
Nov.....35,718			189.83		500.00		0.5			1.4			1.9		
Dec.....41,660			189.83		1000.00		0.5			2.4			2.9		
Total 1955	464,052	56,597	$6406.54,	$621.18	$12,907.75	$893.75	1.4c	1.1c	1.4c	2.8c	1.6c	2.6c	**4.2c**	**2.7c**	4.0c
Jan. 1956...37,198	2,719		$464.03	$256.65	$500.00	$250.00	1.2c	9.4c	1.8c	1.3c	9.2c	1.9c	2.5c	18.6c	3.7c
Feb.....29,550	10,559		620.69	313.57	1000.00	250.00	2.1	3.0	2.3	3.4	2.4	3.1	5.5	5.4	5.4
Mar.....38,976	6,966		896.56		1000.00		2.3			2.6			4.9		
Apr.....48,172	3,165		298.85		1000.00		0.6			2.1			2.7		
May.....47,283	4,125		298.85	97.99	1250.00	62.50	0.6	2.4	0.8	2.6	1.5	2.6	3.2	3.9	3.3
June.....35,294	2,550		878.36	98.58	1125.00	63.50	2.5	3.9	2.6	3.2	2.5	3.1	5.7	6.4	5.7
July.....27,751	3,155		462.30		750.00		1.7			2.7			4.4		
Aug.....42,433			695.29		1310.00		1.6			3.1			4.7		
Sept.....26,810			394.80		1060.00		1.5			4.0			5.5		
Total 9 mos 1956....333,467	33,239		$5,009.73	$766.79	$8,995.00	$625.00	1.5c	2.3c	1.6c	2.7c	1.9c	2.6c	**4.2c**	**4.2c**	4.2c

Drilling Costs

cite, epidote, chalcopyrite, pyrite, powellite, scheelite and molybdenite. Principal minerals occurring in the granodiorite groundmass are quartz and biotite. The tactite is considered the best drilling rock and the wollastonite the toughest drilling rock in the district.

Among the problems brought about by conversion to tungsten mining, rock drilling was of immediate concern. To swing into the tungsten program with minimum delay and because of the time required to equip a steel repair shop, arrangement was made with the Fourth Street Tool Shop of Reno, Nev., to take care of bits and steel under contract. New steel was made up and used steel repaired by the piece with separate charges for threading and shanking. The contractor has spent less than 3 days a week to fill mine steel requirements over the last 5 years. This arrangement solved the problem of equipping and staffing a part-time drill repair shop at the mine.

Open pit mining of the tactite deposits immediately produced tungsten ore to operate the mill while the several underground mines were being developed. Drilling in the open pits is done with I-R FM2 and FM3 wagon drills using a DA 35 drifter with 1⅛-in. round, lugged steel. Four steel changes in 5-ft intervals are made starting with a 6½-ft drill and finishing with a 21½-ft drill. Both vertical and flat holes are drilled, depending on the formation. The tungsten-carbide bits used in the wagon drill steel are I-R Series 118 (shoulder drive, modified reverse buttress, 18/16-in. O.D. thread). Starting bit is 2⅜-in.; the second 2¼-in.; third 2-in.; and fourth a used 2-in. bit.

The reason for the large starting bit is to allow the hose from the pneumatic powder loader to be inserted part way down the hole. Otherwise, a new 2-in. bit followed by progressively used 2-in. bits would have been sufficient as there is little gage loss, and the holes are sprung for proper loading anyway.

Records were kept on the footages obtained with the I-R series 118 tungsten-carbide insert bit. Compared to underground experience with other makes the results have been very good. Drilling records were kept until it was determined that bit life was more than 2,000 ft of hole drilled, establishing a cost of about 1c per foot of hole drilled. This was so satisfactory that no further drilling problem was considered to exist in open bit drilling, and no additional records

have been kept since the first two years of operation.

Underground Drilling Costs Needed Study

When underground tungsten mining first began in 1951, drilling in drifts and crosscuts was done with I-R DA 30 machines mounted on bar and column and used 1⅛-in. round, lugged steel. I-R R 48 and R 58 stopers with 1-in. quarter-octagon steel were used in stoping operations. All steel for the drill units mentioned were threaded for a M series Timken tungsten-carbide bit with an H (shoulder drive, lamp socket, 1-in. O.D.) thread.

As development work progressed and more men and machines were employed in stoping operations, it became apparent that drilling costs were higher than desired. The lighter JR 38 jacklegs and R 38 stopers offered a solution. They used a ⅞-in. hexagonal drill steel with a smaller, FCA series Timken tungsten-carbide bit with F (shoulder drive, lamp socket, ⅞-in. O.D.) threads. It was decided to test this equipment.

To study the costs it was necessary to set up a standard procedure of recording available information in table form that could give quickly and accurately a picture of performance. Forms devised are shown in the accompanying tables.

Bit costs were of primary interest. As the tables show, data were easy to enter. Daily drilling footages are available from the time cards and are totaled at the end of the month. An accurate monthly account of new bits issued to the underground mine is available from the warehouse. Monthly invoices from the bit supplier give the price of bits from which an average cost per bit can be obtained. Total footage drilled during the month divided by the number of new bits issued determines the average footage drilled for each new bit issued. The average cost per new bit issued divided by the average footage drilled per new bit issued results in the average cost per foot of hole drilled.

By this scheme a practical rock drill bit record was built up without the complicated procedure of numbering the bits and consequent cost of supervision. It should be noted that for premature insert failure, the Timken Co. has a policy of no-charge bit replacement. Bits so replaced are not entered on the table.

Smaller Drills Cut Bit Cost

A bit cost saving of 3c per foot of hole drilled with the smaller equipment was apparent from the 1954 table. Based on this ⅓ reduction, recommendations were made to the management to change to I-R JR 38 jacklegs and R 38 stopers throughout the entire underground mine. The heavier stopers with spare parts were offered for sale and the lighter units were purchased. The changeover was complete by the end of February 1955.

Before discarding the heavy drills entirely, one idea to reduce bit breakage was to use a sinker-type front head on the R 48 and R 58 stoper, thereby eliminating the anvil block. This reduces the excessive oscillation of the anvil block or "flutter" set up in the steel, and is thought by some to reduce the multiple partial blows set up in the steel and bits. As more immediate success seemed assured by a complete change to lighter drills, the idea was not tried. The light stoper of the R38A type does have a sinker-type front head without steel holder. When using the heavy drill the bit failure was almost 90% in skirt breakage. This is practically nil with the lighter drills, but some problem does exist with premature insert failure.

Other Benefits Show Up

In addition to the direct saving of 3c per foot of hole drilled in the bit cost alone, there were other factors to be considered in the recommended change to the lighter drills. One of the underground mines of the Getchell Mine group had been using some of the lighter machines and smaller bits for some months prior to the complete changeover. This mine consistently showed a lower powder consumption per ton of ore broken than other mines in the group using heavier machines and larger bits. After the changeover these mines then reduced powder consumption nearly 1 lb per ton of ore broken and were then in line with the mine having a good powder record. This resulted in a substantial saving in powder costs when the major mine of the group produces some 70,000 tons per year, and an item well worth the consideration.

Another factor that influenced the recommendation was the lower consumption of compressed air of the lighter machines. Tables available from the manufacturer on the relative air consumption of the R 48, R 58 and R 38 proved very interesting. It was found that two of the heavier drills could be replaced by three of the lighter units without any increased investment in air compressors. This then added one more drill for every two heavy drills retired and increased the number of working faces in the stopes and consequently increased production.

Additional factors influencing the recommendation to a lesser extent but still worth consideration were: (1) less expensive repair parts for the lighter drills, and (2) the light weight and ease of handling with their definite appeal and effect on the men using the lighter drills.

Drill Steel Was Studied Too

In conjunction with the carbide insert bit study, a record was also made in table form of the cost of various drill steels used underground. Table on drill steel covering 1954, 1955 and 9 months of 1956 is the result of a record on monthly drilling done and resolved into a cost per foot of hole drilled. The costs are given for the new steel in terms of cost per foot of hole drilled, as is the threading and shanking of new and used steel. It will be noted that record on drilling with ⅞-in. hexagonal steel with Timken F thread was not begun until May 1954, when more of the drilling footage was attributed to the jacklegs and lighter stopers. At this time a separation was also made on the ⅞-in. hexagonal steel made up with Timken F thread used in the lighter machines and the 1-in. quarter-octagon and 1⅛-in. round steel made up for the Timken series bit with H thread as used in the DA 30 drifters on the two-machine jumbo and in the R 48 and R 58 stopers. Since February 1955, when the heavy stopers were retired, no further drilling has been done with 1-in. quarter-octagon steel. The only M series bits in use since that time are those of the jumbo mounted DA 30 drifters driving development drifts and crosscuts.

In studying the table it will be noticed that there is no definite trend from month to month largely because of the steel on inventory in the underground mines carried over from one month into the next. However, the total average figures at the end of each year gives a figure that appears often during the year showing some average months.

High labor turnover is the chief cause for the above average months cost. When the jackleg-type drill was first introduced few miners were acquainted with its operation, and a breaking in period was required. This period was one of much broken steel with resultant higher steel cost which also increased the threading and shanking cost. For example, when a miner using a jackleg drill starts a hole with a second steel instead of the conventional starter, the drill is farther from the drilling face and great stress is placed on the drill steel at the drill. The result is a drill steel broken

in the shank or collar. This practice can readily be determined by the increase in broken second steel in proportion to the number of starters in use.

The table also discloses that the total cost for new drill steel for the lighter drills is practically the same as that for the heavy drills in the 29-month average—a considerable saving in cost per foot as there is nearly twice the footage of hole drilled for the small steel as compared to the larger steel. However, the total cost of threading and shanking (an indication of breakage) for the lighter steel is nearly twice that of the heavy steel, which is no gain in cost per foot. This is not considered a serious disadvantage as it is believed better supervision could reduce breakage.

Integral TC Bits Show Promise

In addition to the records kept on the performance and cost of the detachable bits, a one-month's test was conducted with Joy Intraset drill steel. This is an alloy steel manufactured in Canada with an integral tungsten-carbide insert chisel bit. The steel is made up at the factory in predetermined lengths and can be ordered in any desired length for jackleg or stoper. Two JR38A jacklegs driving drifts in ore, limestone and granodiorite were given 8 sets of Joy Intraset Series 1 drill steel for the test. The sets included 8 starters 2½ ft long below the collar with a 1 11/32-in. chisel bit and 8 seconds 5 ft below the collar with a 1 5/16-in. chisel bit. The test was conducted under normal conditions with the usual supervision. A total of 4,995 ft of hole was drilled with the 8 sets, and at the end of the test there were available for added footage 2 starters and 3 seconds. One second was stuck, and the balance of the steel was lost due to breakage, mostly at the collar. None of the steel was lost through premature insert failure.

Conducted over less than a month's time, the test revealed a cost of 5.2c per foot of hole drilled, which is less than half the best total cost of the hexagonal steel with threading and shanking plus the cost of the F series Timken tungsten-carbide insert bit. This single test must not be considered conclusive, but the favorable result indicated does warrant further investigations with a possibility of greater saving in drilling costs.

The method employed at Getchell for sharpening tungsten-carbide insert bits may be of interest. The grinder used is an I-R JA-3 air-driven unit adapted for the work. Proper collets for holding the Timken F and M series bits and the I-R series 118 bit used on the wagon drill are available. The grinder contains two wheels—one 1¾x1¾x12-in. with a K (or vee) face for sharpening, and the other 1x1¾x12-in. with an A (or flat) face for gaging. F series bits are sharpened with a 1x1¾x12-in. K face grinding wheel. All wheels are of the GC 80 L11 VR class in the Carborundum Co. classification and can be either 60 or 80 grit, with the 80 grit preferred at Getchell. They operate at about 3400 rpm, and a stream of water is played on the wheels to eliminate dust. Sharpening and gaging a bit takes only a few minutes, if the bit has not become too dull.

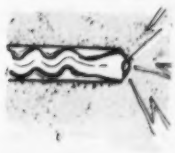
Carrying racks holding 8 bits are numbered and issued to the miner each shift. Extra bits are issued on these racks so that all bits may be used and none of the sets subjected to excess duty. From test work conducted in various working faces in the mine it was determined that an average of from 10 to 12 holes 6 ft deep was sufficient drilling footage for one set of bits if wear was to be held to a minimum.

How To Cut The Life Of Your Drill Steel

NINE LEADING CAUSES of drill steel failures have been cited by Atlas Copco. Data was gathered from the Swedish company's offices in 87 countries around the world.

1. Storing steels in the open. Rain, snow and normal dampness will rust both the exterior and center hole of a steel, leaving a rough surface particularly susceptible to metal fatigue.

2. Handling steels like old scrap. Deep scratches on the outer surface quickly become major structural weaknesses. (For identification purposes, stamp a number into a steel. This makes it easy to find and insures extra speedy breakage.)



3. Forgetting to regrind the steel. That tough tungsten carbide insert will lose its original cutting potential and then the rock drill will damage the rod instead of the rock. You'll crush the insert.

4. Ignoring instructions for grinding steels. Grind the bit just as sharply as you can. Then, while it's still hot, dip it into a bucket of cold water. This is always good for a laugh—and early breakage.

5. Running your drill with too little pressure on the steel. This will make the drill jump on the steel's collar and keep the piston from hitting the steel. It develops particularly high stresses on the rod.

6. Using the pusher with too much force. This helps bend the drill steel, making it break early in the game.

7. Using a rock drill with worn-out rotation device. If the steel doesn't rotate with each blow, it will suffer heavy stresses on both the rod and bit. This means early breakage.

8. Using worn-out chucks and pistons in the drill. This is probably the best way to ruin the shank of your drill steel. That's because the shank will have a tilted position in the rock drill and the piston will hit only one side of its surface. After running your drill a while, the steel's shank will look like a rivet head.

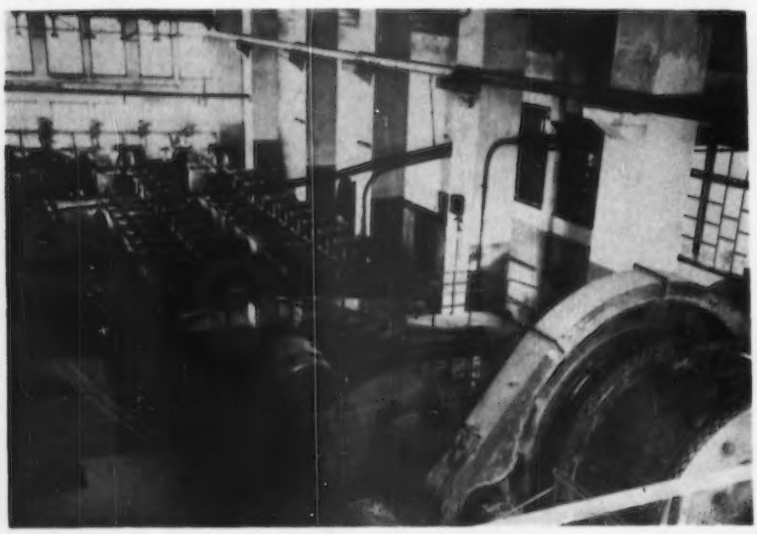
9. Using your steels for scaling. For outright ruin of a good drill steel in the shortest possible time, you just can't beat this method.

USING wet cyclones to deslime, conditioning with sodium sulphide and sodium silicate at pH 11 and 122 deg F, followed by flotation at 45% solids with potassium amyl xanthate and copper sulphate, Gorno is able to recover 76% of oxidized zinc.

How Gorno Recovers Oxidized Zinc

MARCELLO BILLI

USING MODERN ORE DRESSING techniques, cyclones and new flotation reagents, Gorno Mines, one of the world's oldest nonferrous metal producers, is successfully recovering calamine at Azienda Minerali Metallici Italiani's concentrator, Gorno, Italy.



GRINDING to 48 mesh in Breda, 8x4-ft conical ball mill, moving at 22 rpm on 200 hp, liberates the galena and doesn't overgrind the sphalerite and calamine.

Gorno's new plant began operation near the end of 1952, but the mine, located near Nossa, Bergamo Province, Italy, has been active since the days of the Roman Empire, when outcrops were mined.

Its modern history began in 1899, when Old Mountain Co. started mining calamine in earnest. These operations were made possible by the discovery in Europe of a method to recover metallic zinc by feeding roasted sulphides to a smelter. This process had been used earlier in China. Two concentrators were built at the turn of the century, using Carmals Spirek hearth furnaces to calcine the calamine.

Since then, production showed a marked increase only to be hampered by manpower and supply shortage during World War II, when activities were halted. Immediately after the war, property was taken over by Azienda Minerali Metallici Italiani (AMMI), the present owner.

Workings are scattered in an area about ten miles long and five wide,

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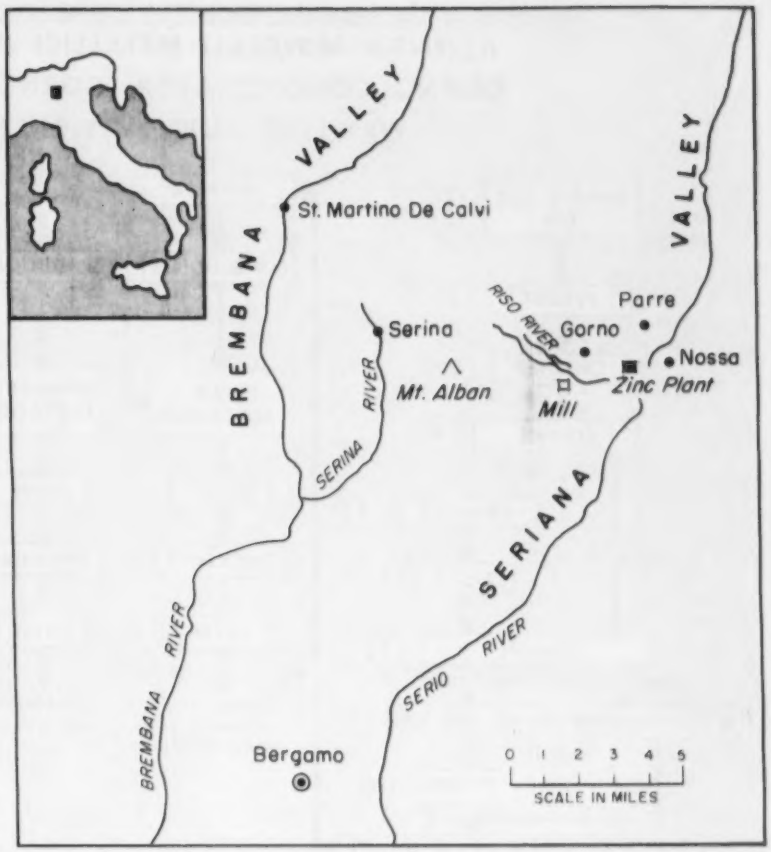
that runs ESE from Val Brembana to Val Seriana—the two main, parallel valleys trending north from Bergamo and cutting through a massive group of the Bergamese pre-Alps.

A brief look at the geology shows that the district is in the Alpine Trias (Triassic belt), which runs through Bergamese pre-Alps from Lake Maggiore on Swiss border, near Varese, west to frontier of Carinthia Province, Austria.

Gorno and the even more important orebodies along the Austrian border at Raibl (Tarvisio) north of Trieste and at Bleiberg (Carinthia Province) are located where the dolomite beds flatten out.



ACTIVE since Roman Empire days, Gorno built a concentrator at Nossa in 1952.

Ore Deposited in Dolomite

The more prominent Upper Triassic of the Bergamese pre-Alps is divided into two groups. Uppermost is a thick, unstratified gray dolomite locally called black limestone, exposed above the Brembana and Seriana Valleys, and at such peaks as Mt. Alben, reaches height of more than 6500 ft above sea level. It forms a protective cloak against erosion over the lower formations.

Orebodies are near bottom of the lower group forming the valley floor. This group, from top to bottom, consists of stratified shale, dolomite, limestone and sandstone. It is about 270 ft thick. Underlying Middle Triassic is another unstratified layer of dolomite some 380 ft thick.

The main structural features are the Grem and the Vedra Fault. The first strikes NS with an average dip of 70 deg W. The second strikes also NS with an average dip of 60 deg W. A comprehensive study of these faults is still to be completed.

Chief minerals are the zinc minerals calamine ($ZnCO_3 + 2ZnCO_3$) and ($3ZnOH_2 + Zn2SiO_4 + H_2Zn_2SiO_5$), and sphalerite. Lead occurs as cerussite and galena, the last usually found near the contact between the metalliferous limestone and the overlying formation.

According to Lindgren, Gorno deposit is a result of metasomatic impregnation in the limestone by mineralized mesothermal solutions. These deposits are supposed to be originated at a depth ranging from 3,280 to 13,000 ft under a pressure of 1420 to 5700 psi and a temperature varying from 347 to 572 deg F.

According to DeSitter, the general order of the phase of impregnations is probably as follows: sphalerite; quartz; fluorspar; calcite, galena, silver-bearing minerals and tetraedrite; tennantite and pyrargyrite; and finally calcite.

Accessory minerals in the ores are: pyrite, chalcopyrite, calcite, quartz, barite and minor fluorite.

Oxidation of sphalerite into calamine and of galena partially into cerussite is due to the superficial alteration which has followed the primary phenomena. Other secondary phenomena took place in the course of the geological periods both in the ore and in the gangue, as silicization at Mount Trevasco and the dolomization in other zones.

Ore occurs as chimneys, fissures and interbedded fillings covering, as known so far, a mining area of some 50 sq miles. Deposits are thought to follow pre-mineral faults and fractures which are considered to be channelways for mineralizing solutions.

Little Timber Needed

Mining is done chiefly by horizontal cut-and-fill stoping, although pillar method and gophering are sometimes used in old stopes. Where underground sorting is not sufficient to supply the necessary quantity of filling, waste rock is supplied by blasting the walls.

Careful sorting is necessary to maintain an average mine-run-ore assay of 8.5% Zn. A central mechanical sampling plant, at the ropeway main station where 75% of the mine production is conveyed, provides for a positive control of the zinc content in the run-of-mine.

Very little timbering is required in the mining operations. As in development workings, stulls are sometimes the only support necessary.

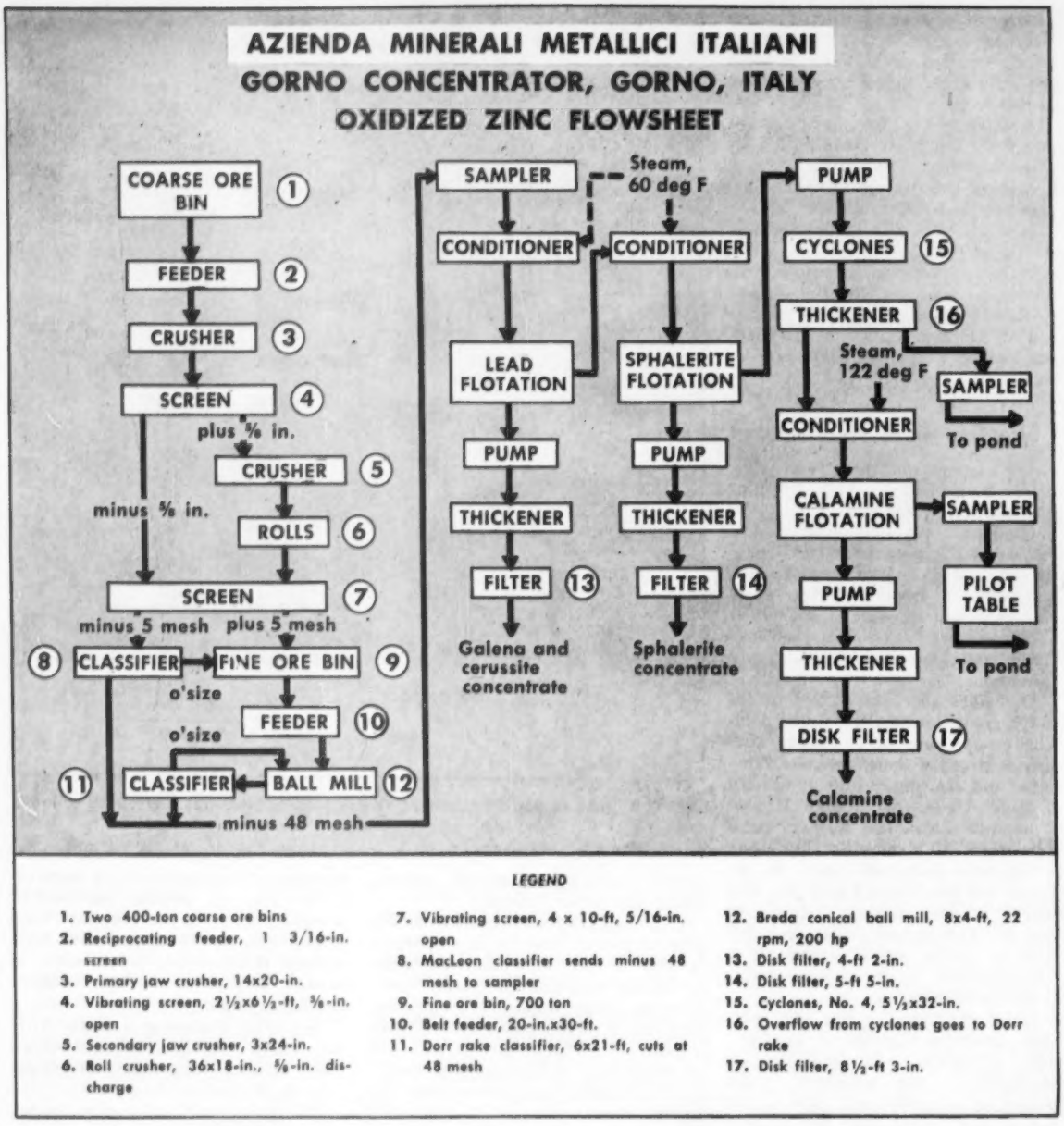
Mining is now in progress from the 1620- to the 5100-ft level. No shaft is actually in operation, as mine is served only by inclines and adits.

Exploration is done by drifts and crosscuts all along the width of the metalliferous limestone. Diamond drilling is carried on underground whenever geological investigation justifies such a procedure.

Current trend is to carry on development work to increase sulphide ore reserves. This has the following advantages:

(1) Higher mill recovery with sulphide ore in comparison with oxidized ore.

(2) Less consumption of flotation reagents.



LEGEND

1. Two 400-ton coarse ore bins
2. Reciprocating feeder, 1 3/16-in. screen
3. Primary jaw crusher, 14x20-in.
4. Vibrating screen, 2½x6½-ft, ⅝-in. open
5. Secondary jaw crusher, 3x24-in.
6. Roll crusher, 36x18-in., ⅝-in. discharge
7. Vibrating screen, 4 x 10-ft, 5/16-in. open
8. MacLeon classifier sends minus 48 mesh to sampler
9. Fine ore bin, 700 ton
10. Belt feeder, 20-in.x30-ft.
11. Dorr rake classifier, 6x21-ft, cuts at 48 mesh
12. Breda conical ball mill, 8x4-ft, 22 rpm, 200 hp
13. Disk filter, 4-ft 2-in.
14. Disk filter, 5-ft 5-in.
15. Cyclones, No. 4, 5½x32-in.
16. Overflow from cyclones goes to Dorr rake
17. Disk filter, 8½-ft 3-in.

(3) Production of sulphuric acid at the electrolytic zinc plant.

As sulphide ore is found in appreciable amount under the water table, dewatering is now in the program for sinking down dip along the main ore column.

Quantity of water flowing into deepest mine levels varies widely depending on the season of the year. This fluctuation prevails because the 75-in. average annual rainfall of the district percolates directly into the subsurface strata, and surface runoff is almost negligible.

A 160-hp, 800-gpm, 525-ft-head Ritz submersible centrifugal pump has already been installed at the 1500-ft level.

Early Recovery Low, Costs High

First gravity concentrator was brought into operation in 1891 at Oltre il Colle and two other plants were successively built at Oneta and Gorno for handling Val Seriana's ore.

Owing to ore characteristics, a satisfactory recovery was never obtained, reaching a maximum of 40% of the total zinc. Calamine being light, spongy and porous, was only partially recovered due to the little difference between its specific gravity and that of the light gangue minerals.

Another difficulty lies in obtaining a good recovery for lead. In the repeated crushing required for obtaining high-grade concentrates, a great deal of fines, rich in lead, were produced which could not be recovered on shaking tables.

Some improvement was made in 1927, by modifying the gravity flowsheet for hand sorting, batch grinding and adding new equipment for treating the fines.

Recovery was 60% but with such a high operating cost that the mine was obliged to remain idle during the period of depressed zinc prices.

Table I—Most Minerals Released at 48 Mesh

(Figures indicate per cent on each fraction)

Minerals	Mesh						Micron					
	35	48	65	100	150	200	92	70	57	36	25	15
Cerussite	42.95	100.00	100.00	100.00	100.00	80.28	100.00	100.00	100.00	100.00	100.00	—
Galena	18.22	40.00	33.33	100.00	60.00	67.05	100.00	100.00	100.00	100.00	100.00	76.66
Sphalerite	28.52	100.00	78.02	80.80	100.00	96.85	89.38	94.91	98.87	96.62	100.00	100.00
Calamine	73.70	91.80	88.03	80.20	80.28	99.20	91.47	94.01	96.30	97.86	97.65	98.22

Table II—Cyclone Overflow Is Minus 200 Mesh

Underflow				Overflow			
Mesh	Size Micron	Per cent retained	Per cent cumulative	Mesh	Size Micron	Per cent retained	Per cent cumulative
35	.....	5.50	5.50	200	.....	0.11	0.11
48	.....	10.50	16.00	250	.....	0.00	0.11
65	.....	13.50	29.50	270	.....	0.17	0.28
100	.....	13.50	43.00	325	.....	0.40	0.68
150	.....	8.50	51.50	...	43 to 25	0.49	1.17
200	.....	9.50	61.00	...	25 to 10	1.49	2.66
...	95 to 63	0.16	61.16	...	10 to 5	23.84	26.50
...	83 to 55	5.70	66.86	...	under 5	73.50	100.00
...	57 to 39	5.62	72.48				
...	40 to 28	4.68	77.16				
...	28 to 20	2.88	80.04				
...	20 to 12	1.24	81.28				
...	under 12	18.72	100.00				

Table III—Classifier Overflows at 200 Mesh

Mesh	Size Micron	Per cent retained	Per cent cumulative
+ 35	..	4.00	4.00
+ 48	..	10.50	14.50
+ 65	..	11.30	25.80
+100	..	10.30	36.10
+150	..	8.70	44.80
+200	..	6.00	50.80
...	+82	0.98	51.78
...	+69	4.33	56.11
...	+52	4.43	60.54
...	+37	3.74	64.28
...	+24	2.66	66.94
...	+15	1.48	68.42
...	−15	31.58	100.00

At the beginning of World War II, flotation was undertaken for the run-of-mine ore in which sphalerite was prevailing, while gravity concentration was maintained for calamine ore.

Hauled ore averaged 8% Zn of which about 6% was sulphide and 2% was oxide. Latter was completely lost, as it was not amenable to flotation. Consequently, the over-all recovery was relatively low.

Present Recovery Is High

After a long period of studies and laboratory tests carried on by Vittorio Manfredi, Gorno's most experienced mill superintendent, satisfactory results were reached to warrant construction of a 420-ton concentrator to float lead, zinc sulphide and calamine selectively. This plant started operation near the end of 1952.

Underground crude ore, amounting to about 9200 metric tpm is conveyed to the concentrator by 32 ropeways and 5 diesel locomotives and dumped into two 450-metric-ton bins.

Crushing division has two identical sections each with a capacity of 600 tpd. Units are arranged as shown in the flowsheet (blending of the ores is required for the best operation of the mill).

Ore drawn from each of the bins is fed to a 14x20-in. jaw crusher through a reciprocating feeder-screen, 1 3/16-in. screen over a length of 40 in.

Due to the sticky nature of much of the ore, wet crushing is required to avoid jamming.

The 1 3/16-in. material and the crusher product are passed through a 2½x8½-ft vibrating screen fitted with punch plate, ⅝-in. open. Plus ⅝-in. is discharged to a 20-in. by 35-ft belt conveyor leading to another 6x24-in. jaw crusher whose product falls directly into a 36x18-in. set of crushing rolls.

Minus ⅝-in. and the roll product are combined through a 4x10-ft vibrating screen covered with hard steel plate having ⅛-in. apertures. Screen oversize falls onto a 20-in. x 49-ft conveyor belt that runs to the 700-ton fine ore bin, while undersize gravitates to an 8-ft McLean classifier.

The McLean underflow is delivered

Table IV—Reagents for Each Mineral

Reagent	Lb per ton	Concentration	Point of addition
FOR LEAD			
Soda ash	0.488	10%	Classifier overflow
Sodium silicate	1.956	50%	
Sodium cyanide	0.088	5%	
Sodium sulphide	1.766	15%	
Potassium amyl xanthate	0.176	10%	Conditioner
Cresylic acid / Aerofloat 31 / Aerofloat 15	0.278	Undiluted	Head of roughers
FOR SPHALERITE			
Soda ash	0.488	10%	Conditioner
Copper sulphate	1.501	15%	
Potassium ethyl xanthate	0.110	10%	Head of roughers
Pine oil	0.026	Undiluted	
FOR CALAMINE			
Sodium silicate	2.914	50%	1st conditioner
Sodium sulphide	8.168	15%	
Potassium amyl xanthate	0.486	10%	2nd conditioner
Copper sulphate	2.936	15%	4th conditioner
Petroleum naphtha	1.324	Undiluted	
Sodium silicate	1.000	50%	
Pine oil	0.088	Undiluted	

Table V—Breaking Down Power Demands

Fuel oil	16 lb per ton
Ball consumption	0.24 lb per ton
Power consumption kwh per ton:	
Crushing	2.42
Grinding	9.33
Flotation	10.76
Cycloning	2.28
Filtration	1.76
Pulp heating	0.70
Subtotal	27.25
Lighting	0.45
Total kwh per ton treated	27.70

Table VI—Results Prove the Method

		Per cent Zn total	Per cent ZnO	Per cent ZnS	Per cent Pb total	Per cent PbO	Per cent PbS
Heads		8.50	6.30	2.20	1.00	0.7	0.3
Concentrates	Lead	6.60	.....	.....	60.00	39.0	21.0
	Sphalerite	59.60	1.00	58.60	1.20	....	....
	Calamine	38.90	38.30	0.60	0.60	....	....
Tailings		1.97	1.79	0.18	0.11	....	....
Per cent recoveries		79.74	76.43	89.24	79.50	....	....

to the bin conveyor, while overflow enters the Pb flotation circuit together with the mill classifier discharge. Fine ore is drawn from the bin by two gate feeders and fed to the mill through a 20-in. x 35-ft belt conveyor.

The 8x4-ft, Breda, conical ball mill moving at 22 rpm on 200 hp, operates in closed circuit with a 6 x 21-ft, Dorr, duplex rake-classifier; grinding at 48 mesh. This mesh is necessary to avoid overgrinding cerussite, sphalerite and calamine and to liberate the galena.

Recent micrographic investigation of the ore has led to the values on liberation degree for each mineral and for sizes from 35 mesh to 15 micron. See Table I. Here, each mineral is shown with its individual per cent liberation at each fraction. Note that while galena is liberated 100% at 100 mesh, it is only 60% liberated on 150 and 200 mesh.

Somewhat the same variations occur for sphalerite on 65 and 100 mesh. Calamine does not attain full liberation on any fraction noted, reaching its highest goal at 200 mesh and 15 micron.

Micron sizes were obtained by elutration method of sub-sieve sizing.

Pulp, after sampling, flows to selective flotation department consisting of three banks of 43-cu ft, 40x40-in. Manfredi cells with an impeller speed of 325 rpm.

Lead flotation is carried on in the first circuit, then comes the sphalerite circuit whose tailing represents the heads for the calamine section, as shown. Pulp pH is 7.4 in the lead circuit and 7.7 in the sphalerite.

Conventional reagents are used in the first and second circuit, while those we employ in the calamine bank represent the key feature of the Gorno operation.

How to Get the Calamine

Tailings from the sphalerite section are sent to a set of No. 4 5½x32-in cyclones through a 4-in Wilfley pump with a feed pressure of 28 psi. These recently installed cyclones successfully separate slimes harmful to the calamine circuit.

Cycloning has overcome abrupt changes in the ore and lowered reagent consumption—in particular that of copper sulphate stepped down from 5.3 to 2.936 lb. Efficiency of this apparatus is shown in screen-analysis back in Table II. Our cyclones overflow at 200 mesh, but most of the pulp is minus 10 microns — 97% as is shown. Underflow averages 61% plus 200 mesh and joins Dorr underflow.

Several materials of construction have been tested to withstand the wear of the apex valves, among which are: glass, bonded ceramic, soft rubber and titanium-steel alloy. The last one has proved to be by far the most satisfactory.

Cyclone overflow gravitates to a 21-ft Dorr thickener whose overflow s sent to waste after automatic sampling and discharge volume measuring. In this instance, the classifier is overflowed at 200 mesh, and shows average 50% plus and minus 200 mesh, as indicated in Table III on previous page.

Pulp Is Steam-Heated

Thickened pulp, both from the Dorr and the cyclones, is laundered to the first conditioner of the calamine circuit, fitted with submerged coils where live steam raises the temperature to 122 deg F. This is held constantly at this rate at any season. Pulp heating is essential in the first, sulphidizing-phase of the zinc-oxide ore.

Live steam is produced by a 810-sq ft tubular boiler at 57 psi with an average consumption of 2 gal fuel oil per ton treated. Reagents we use in this circuit and their points of addition are specified in Table IV.

A specific set of reagents is used to recover the lead, the zinc and the calamine.

In Table V on previous page, we have listed the fuel oil, ball and power consumption in our flowsheet. Total electrical demand is 27 kwh per ton, with two-thirds of this total being consumed in crushing, grinding and flotation. Cyclones require only about 10% of the total demand.

Careful and complete conditioning is a very important step in calamine flotation and every attention is given to avoid an excess of sodium sulphide in the pulp before the addition of copper sulphate, as the latter is neutralized by the former as following the reaction:

$$2\,Na_2S + 2CuSO_4 \rightarrow CuS + NaSO_4 + S$$

Lead acetate solution 1:1,000 is employed to reveal the presence of Na_2S in the pulp.

Following advice of Maurice Rey, professor, School of Mines, Paris, we have ceased titrating by the iodine method. Na_2S forms by the oxidation in the pulp of many compounds such as sulphites, hyposulphites and thiosulates which are in themselves reducing agents.

Addition of sodium sulphide and silicate in the first conditioner raises pH to 11, successively reduced to 10.5 by the addition of the remaining reagents.

Before the use of cyclones both these figures were 1 point higher.

Pulp enters the calamine flotation at 45% solids. Details of our cleaner and rougher cell arrangement are shown in the flowsheet, while our actual metallurgical results are given in Table VI.

As calamine flotation through this system may be susceptible to further improvements, we are constructing a pilot plant to carry on tests without altering our present operation.

New Zinc Plant at Nossa

On the instigation of Ernesto Cianci, managing director of the corporation, a new electrolytic zinc plant, the largest now operating in Italy, has been recently erected at Nossa, one mile from Gorno.

Projected by Livio Cambi, Professor of Industrial Chemistry at the University of Milan and with Ing. Marcello Billi as Buildings Director, plant construction was begun by the end of 1949 and we started production in June 1952.

Process involves roasting of sphalerite ore on Nichols hearth furnaces, with sulphuric acid recovery; calcining and sulphatizing of calamine ore in Humboldt furnace; two leaching operations; purification and final electrolytic deposition of zinc from the sulphate solution by low acid, low current density method. (For a comprehensive report, see: *E&MJ*, May 1954, p 68.)

Plant is treating not only the Gorno zinc ores but also those of six other AMMI mines in northern Italy and on Sardinia. Actual zinc metal production of the plant averages 55 tpd, with cadmium, copper, cobalt and manganese dioxide as by-products. Metallurgy of lead ores is in the offing to complete the plant.

Track-Type for Power

For maximum power, tractive effort and short-range hauls track-type tractors and bulldozers win out.

Wheel-Types Offer Greater Speed

If road surfaces are smooth and hauls long enough, rubber-tired units speed up the earth-moving job.

Track and Wheels in the Open Pit—Where Do They Perform Best?

JOHN RADOMSKY

SELECTION OF THE RIGHT TYPE of equipment for the job at hand requires not only knowledge of the job, but also the area of application in which the equipment will operate economically. It is not a question of, "Which should I use, tracks or wheels?" but rather, "Under which conditions should I use tracks and under which should I use wheels?" Each has its proper application. The type of equipment selected depends upon which will do the work more economically.

There are many factors affecting the selection of equipment, prominent among these are power requirements, ground conditions, haulage distance, future requirements, etc. All of these factors are interdependent. For discussion purposes and to show their interdependence, each one will be covered separately.

There is only a certain amount of power available in any given vehicle. This available power must be equal to or be greater than the power requirements and power limitations. Power limitations, in earth-moving, are traction and altitude, while the power requirements are rolling resistance and grade resistance.

Traction is the ability of the tracks or wheels to grip the ground and is determined by the weight of the vehicle and the coefficient of traction. Traction varies with the weight on the machine itself. No tractor, operating on the ground or a road, can exert pounds pull which are in excess of its own weight. And, only the weight on the driving wheels (or tracks) affects the tractive effort of the machine.

Altitude affects the power output of any engine. As the machinery operates at higher elevations, the air becomes rarefied and incomplete burning of the fuel is evidenced in smoky exhaust. This means that the available horsepower in the fuel is not being utilized at this higher elevation. Engines are, therefore "derated" and produce less horsepower at altitude than at sea. level. "Normalizing" is the act of altering the engine to deliver sea level horsepower at higher elevations.

Rolling resistance is the retarding force of the ground against the wheels of a vehicle, which must be overcome before the vehicle will move. Many things determine rolling resistance. Some of them are tire pressure, tire design, and internal friction of the machine. In a properly functioning machine, however, these things are constant. Ground conditions do, however, vary widely, changing the rolling resistance considerably.

Since track-type tractors always roll on their own tracks, which are hard and smooth, there is no requirement to overcome rolling resistance. However, if they pull wheel equipment, the rolling resistance of the towed unit must be overcome.

In the case of wheel tractors, rolling resistance works against the tractor as well as the trailed unit since both ride on wheels.

Grade resistance is caused by the pull of gravity on the entire unit. It acts against the total weight of the unit, whether it is a track-type or wheel-type tractor. When the grade is uphill (adverse) to the direction of travel, the effect is a demand for power or an added power requirement. If the grade is downhill (favorable), the effect is a lessening of the power requirement. If the terrain is level, there is no requirement to overcome gravity, only rolling resistance is a factor.

Ground conditions greatly affect the power requirements, and are probably the most important single factor affecting equipment selection. A soft, muddy surface (or sand) has the greatest rolling resistance because of the deep penetration by the wheels. Along with this, traction coefficient is reduced for both track-type and rubber-tired tractors. Under these conditions, the track-type tractor will be able to do more work than rubber-tired tractors because rolling resistance is not a factor to consider when using tracks. The better flotation of the track-type tractor is another factor in its favor when oper-

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Track-Type Assist for Rubber-Tired Haulers

In the high-speed hauling zone a combination of power and high speeds gives best results. Rubber-tired tractors with scrapers (foreground) or wagons (background) are economical if roads are good and haul is long.

Track-Type Puller for Rubber-Tired Haulers

In the slow-speed hauling zone a combination of power traction, high capacity and moderate speeds is ideal. The track-type tractor pulling the wheel-type scraper-hauler meets these requirements best.

ating in sloppy, underfoot conditions.

The other extreme is concrete, which offers very little rolling resistance and high tractive effort to rubber-tired equipment. But for track-type tractors, the coefficient of traction is very low, since the grousers will not penetrate the surface.

If the ground condition is bumpy or rutted, but firm, then track-type tractors would again have the advantage, since the high speeds of the rubber-tire equipment could not be utilized. If the surface were smooth, firm earth, and the haul distance long enough, rubber-tired equipment would have the advantage because of its high speeds. A well maintained haul road pays off in increased production through high speed decreased equipment maintenance, greater machine availability and decreased operator fatigue.

Of course, when selecting any equipment, future requirements, production, haulage distances and grades should be kept in mind so that presently purchased machinery will integrate with future purchases to form a highly productive package.

Contrary to old ideas, track-type equipment (bulldozers and scrapers) and rubber-tired equipment do not have definite dimensional bounds, but overlap to an extent which is determined by power requirements, ground conditions haulage distances and grades. However they can be grouped into flexible zones. These are: power zone, slow speed hauling zone, and high speed hauling zone.

In classifying equipment in this manner, it should be clearly understood that the zones of operation are very loosely defined and often-times overlap.

Power Zone

The power zone demands maximum power and tractive effort for short range work. The principal unit in this zone is the track-type tractor and bulldozer, because a high percentage of its total weight is available for traction.

Side casting of overburden can be done very economically with a bulldozer, because the push distances are usually short. This method can be used to strip to the deposit if it is not too deep.

If a shovel or dragline is used for stripping overburden, its production of exposed ore can be increased, without increasing the size of the shovel by the addition of a track-type tractor and bulldozer. As an example, a coal company in Alabama needed to increase the stripping capacity of their 7½-cu yd dragline. This meant trading the dragline for a larger machine, a very substantial investment, or boosting the production with another piece of equipment. They chose the latter and purchased a 300-hp tractor and bulldozer.

Overburden in the strip mine averaged 70 ft and contained 40% sandstone. It was drilled and shot, then the tractor and bulldozer stripped 30 ft of overburden to stay ahead of the dragline. The addition of the tractor and bulldozer increased the stripping production by 50%.

Reclamation of spoil banks in strip mining has presented a major problem. This extremely rough terrain dictates the use of the track-type tractor and bulldozer because of their maneuverability, gradeability and high production over the short distances.

Land clearing for dragline work and wagon or scraper hauling requires the power, traction, and maneuverability of the track-type tractor and bulldozer.

Slow Speed Hauling Zone

The slow speed hauling zone combines power, traction, high capacity and moderate speeds to move materials. The track-type tractor scraper is the primary tool for this zone. The tractor scraper is a very versatile unit, being able to dig, transport and spread material very efficiently. Besides self-loading and transporting large loads at moderate spreads the tractor scraper can pioneer side hill cuts, haul boulders, do finish work and be shovel loaded.

Under good operating conditions, rubber-tires units could operate in this zone, but in slightly adverse conditions; rough terrain, poor weather, adverse grades and short cut and fill areas, the track-type tractor scraper will prove to be the more efficient unit.

High Speed Hauling Zone

The high speed hauling zone, as the name implies, combines high speeds with power to give maximum production. Where hauls are sufficiently long and conditions favorable, the two- or four-wheel rubber-tired tractors, with attached scraper or wagon unit, can be applied. High travel speeds must be maintained to obtain the economical production from rubber-tired units. In order to operate at high sustained speeds, the haul road must be well maintained. No operator will subject himself to long hours of rough riding on poor 'roads'—he will reduce his travel speed.

A choice of wagons or scrapers will depend on several factors. It should be emphasized that each job must be considered a special problem, all factors being studied before a recommendation of equipment can be made.

Wagons can handle blasted material and large size material easily. They also can stay on a firm footing while being loaded by a shovel, dragline, elevating grader, clamshell, etc. The wagons offer larger targets and have greater capacity than scraper units.

Scrapers can be loaded by the same means as wagons, but do not offer as large a target. Along with this, scrapers can be push-loaded and can pick up material at any location when selectivity is needed. Push-loaded scrapers have shorter loading times than do shovel or dragline-loaded wagons and are independent in operation.

The scraper is limited as to the type of material it can handle. Large boulders and large-size blasted materials are hard to load, increasing the loading time with an attendant decrease in production.

The selection between scrapers and wagons depends largely on equipment already owned and available and, as we have seen, the type of material and job conditions.

The following examples will point out how the selection of equipment is affected by changing but one condition.

Track-Type Tractor Bulldozer vs Scraper

Job conditions:
Haul distance—200 ft
Ground conditions:
Loose earth
R.R. = 150 lb per ton
No grades

Tractor with bulldozer
Production—245 cu yd per hr
Hourly owning and operating cost of tractor and bulldozer = $6.94

$$\text{Cost per cu yd} = \frac{694}{245} = 2.8 \text{ c}$$

Same tractor with scraper
Production—340 cu yd per hr
Hourly owning and operating cost of tractor and scraper = $9.55

$$\text{Cost per cu yd} = \frac{955}{340} = 2.8 \text{ c}$$

If a 12% adverse grade was encountered on the return, and other conditions remained the same, the cost would be as follows:

Tractor and bulldozer
Downhill and trench dozing increases the dozer production approximately 60%.
Production = (245 × 0.6) + 245 = 393 cu yd per hr
Hourly owning and operating cost of tractor and bulldozer = $6.94

$$\text{Cost per cu yd (bank)} = \frac{694}{393} = 1.7 \text{ c}$$

Same tractor and scraper
Production—289 cu yd per hr (bank)
Hourly owning and operating cost of tractor and scraper = $9.55
Cost per cu yd (bank) = 3.3 c

Under these conditions the bulldozer unit will operate more economically at the 200-ft haul distance, or can be applied over a haul distance of 300 ft with a cost equal to the scraper unit.

Track-Type Tractor & Scraper vs Rubber-Tired Tractor & Scraper

Job conditions:
Haul distance—1,000 ft
Ground conditions:
Firm earth
Rolling resistance = 150 lb per ton
No grades

Track-type tractor-scraper
Production—200 cu yd per hr
Hourly owning and operating cost of tractor and scraper = $9.55

$$\text{Cost per cu yd} = \frac{955}{200} = 4.8\text{c}$$

Rubber-tired tractor scraper
Production—294 cu yd
Hourly owning and operating cost of tractor and scraper = $11.21

$$\text{Cost per cu yd} = \frac{1121}{294} = 3.8\text{c}$$

Cost per cu yd for pusher = 1.0c
Total cost per cu yd = 4.8c

If an 8% adverse grade was encountered on the return and other conditions remained the same, the cost would be as follows:

Track-type tractor scraper
Production—200 cu yd per hr
Hourly owning and operating cost of tractor and scraper = $9.55

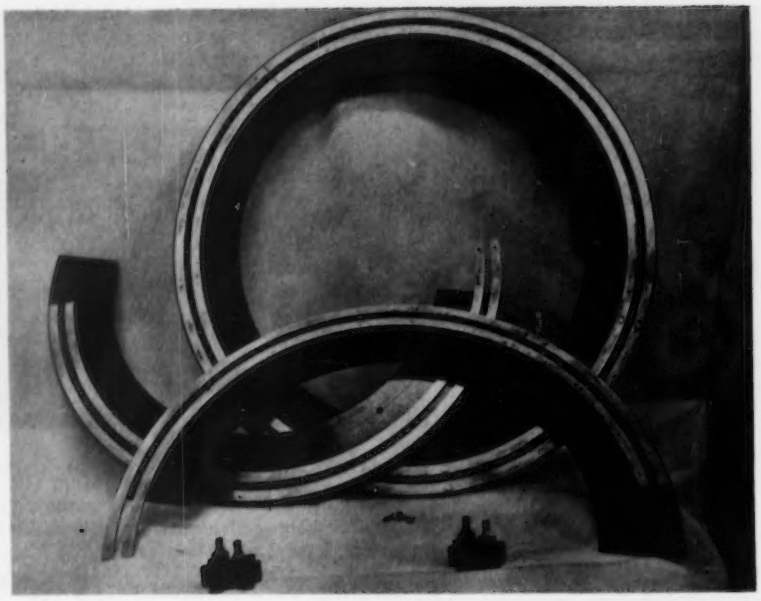
$$\text{Cost per cu yd} = \frac{955}{200} = 4.8\text{c}$$

Rubber-tired tractor scraper
Production—204 cu yd per hr
Hourly owning and operating cost of tractor and scraper = $11.21
Cost per cu yd = 5.5c
Cost per cu yd for pusher = 1.0c
Total cost per cu yd = 6.8c

With the addition of more power, different speed ranges, better techniques of job operation, and greater capacities, the differences between the zones of operation become less and less defined. The proper selection of equipment will then require more complete analysis to provide the most economical solution.

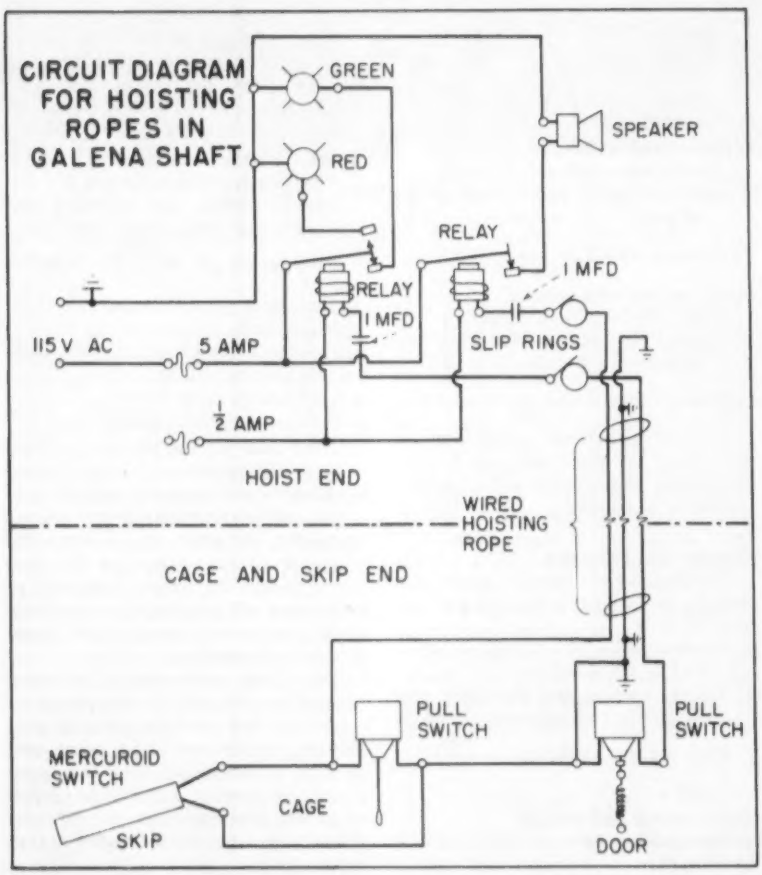
The rising cost trends of today require the selection of equipment be such that the greatest possible production be obtained from every unit on each particular job. This is accomplished by keeping in mind the factors of power requirements, ground conditions, haulage distances and future requirements.

ELECTRIC CONDUCTORS are securely embedded in hemp core of rope.



TWO COLLECTOR RING assemblies with carbon brush holders are mounted in ⅜-in. Micarta base. One is split to show overlapping of brass slip rings.

Wired Hoisting Ropes Provide Positive Shaft Signal



S. E. ZELENKOV
A. W. BECK

FOR MOST UNDERGROUND MINES the use of wired hoisting rope is novel, but it simplifies signaling from the moving cage and skip to the hoisting engineer and reduces maintenance. The need is particularly important when the shaft is situated in bad ground and there is a possible chance of the cage and skip "hanging up" in a tight place. At AS&R's Galena mine near Wallace, Idaho, it also provides a positive indication to the hoisting engineer whether the bottom dump skip door is open or closed after dumping.

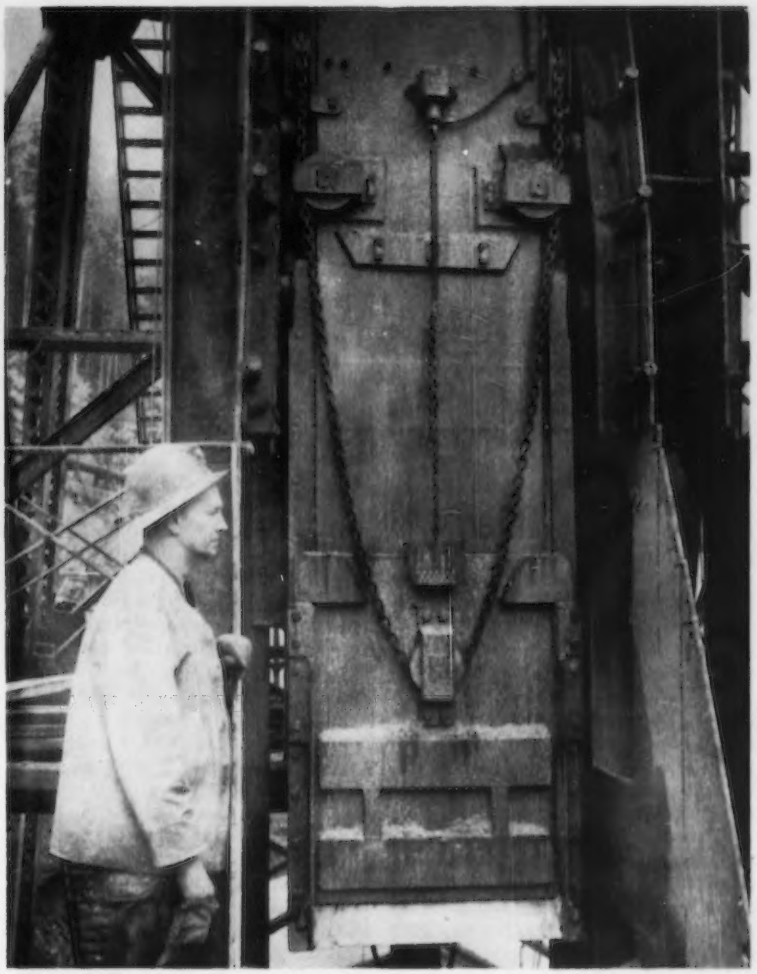
Although it's true that mechanical abuses which the hoisting rope is subjected to through bending, reeving, stretching and winding make it very difficult to maintain undamaged insulated copper wire conductors within a wire rope core, the problem is not insurmountable.

In 1940, Federal Mining & Smelt-

Mr. Zelenkov is assistant manager and Mr. Beck is electrical superintendent of American Smelting & Refining Co., Northwestern Mining Department, Wallace, Idaho.

CONNECTOR CAP on the cage end of the wired rope requires sturdiness.

Power for System



OPENING AND CLOSING of the skip dump door actuates the pull switch above the door to indicate position of door, through a chain and brass spring linkage.

ing Co., now merged with the American Smelting & Refining Co., first experimented with the installing of two insulated copper conductors within a flat hoisting rope at the Morning mine, Mullan, Idaho. This hoisting rope was made up of 13 strands of ⅜-in. diameter steel rope, sewn together with soft iron wire and forming a hoisting cable ⅜ x 4¼ in. Two strands were especially made containing insulated copper wire in the cores but when the cable was placed in service the conductors were grounded out in a few hours.

During the following years electronic signals were installed as standard equipment in three of the company's properties in the Coeur d'Alene district. The basic principle of electronic signals, or a carrier current system, can best be explained by saying that radio frequency energy is fed into the hoisting rope by a transmitter in the cage and delivered to a receiver situated near the sheave wheel.

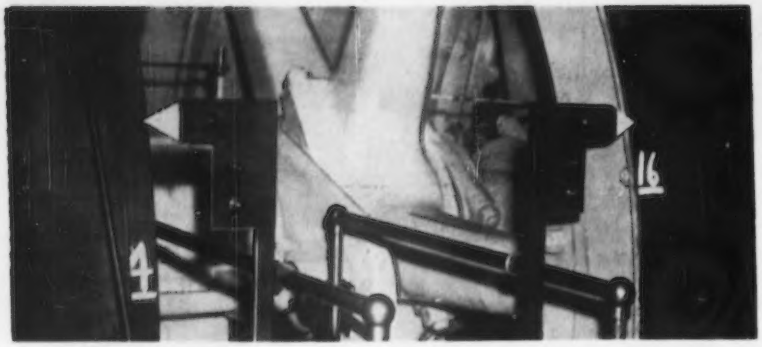
Electronic devices worked erratically, required constant service and maintenance, and were limited in their application. They were able to do only two of three required jobs—sending of hoist signals, indicating slack rope and showing the position of the skip door. An independent circuit was required by the skip door. This is now provided by the wired hoisting rope.

Several rope manufacturing companies are now making steel hoisting ropes with multi-conductor insulated stranded copper wire installed within the core of the rope. With the use of new materials such as nylon cord and plastic insulation, and application of an entirely new idea of spiral winding of copper wires to form an insulated conductor, life expectancy of the conductors in the rope should equal that of steel rope itself.

Specifications of a hoisting rope purchased by the company for use at the Galena mine near Wallace, Idaho, are: 1⅝-in. 6x19 preformed, improved plow steel, right lay, lang lay, hemp or fibre core rope, furnished with a 3-conductor, color-coded, equivalent to No. 22 AWG copper wire with a resistance of 25 ohms per 1,000 ft. Conductors to be imbedded in core as shown in accompanying photograph (above, left).

Design of Collector Rings Important

When planning an installation of wired hoisting rope, the first consideration is the design of collector rings and their adaption to the hoist drum or drums. Each of the two drums of the main hoist at the Galena mine has a flat-faced gear mounted on the drum near the center bearing. These gears provide an excellent mounting surface for the collector rings. They are about 30 in. in diameter and drive the Lilly controllers. The brass collector rings are mounted flat in a coaxial position spaced ⅜-in. apart on a ⅜-in. thick



PILOT LIGHTS on each end of drum turn from green to red when skip door is open.

Micarta circular base as shown in photo on p 90.

Each collector ring and the Micarta base are split, forming two 180-deg segments. Rings overlap on the base to give it better mechanical strength and alignment when assembled. The 8-32 flat head mounting bolts securing the rings are countersunk ⅛-in. in the back of the Micarta base to provide sufficient insulating clearance between the base and the gear face. A sheet of 0.025-in. insulating paper is also inserted between the ring assembly and gear. The collector ring assembly is bolted to the gear face with 10-32 brass round head bolts.

After the unit is completely mounted, the ends of the collector rings are soldered together and dressed down smooth with a file and sandpaper. Two lengths of No. 14 stranded insulated wire are passed through the 3/16-in. holes alongside of the collector rings and the ends soldered to the side of their respective rings. These are cabled and lead to the hoist rope cap.

The carbon brush unit can be made up of almost any design to match the rings. The one selected has the correct brush spread to fit the collector ring mentioned. Rim speed of the rings is quite high on fast hoists, and correct carbon brushes to control brush and ring wear should be selected carefully.

Another important item is the terminating cable connector cap for the end of the hoist rope. From the cage end of the rope, the wires protrude upward and may be subjected to injury due to falling rock and water. A sturdy cap is necessary for protection. The type shown in photograph has given satisfactory service.

A hub was machined to fit over the hoist rope end with an opening large enough to let the conductors pass through and still provide a rest against the end of the hoisting rope. Two small hubs are welded in opposite positions on the main hub, drilled and tapped for set screws to fasten the unit securely to the steel cable.

A 1½-in. pipe coupling, having two ½-in. pipe couplings welded at a 45-deg angle, is attached to the main hub. This coupling provides a chamber to make up the connections.

Crouse-Hinds CBG's (½-in.) are placed in the ½-in. couplings to receive the two No. 12-2 conductor portable cables that lead to the switches on the cage and skip. After the conductors are made up the 1½-in. coupling is closed with a pipe plug treated with sealing compound, making a sturdy waterproof cable connector. A similar one is used at the drum end of the hoisting rope.

Installation on the skip and cage consists of three units:

(1) A signal pull switch situated under the bonnet of the upper deck with the pull wire passing through a ½-in. pipe to the lower deck of the double-deck cage. It is used to start and stop the cage from any place in the shaft at any time.

(2) A metal clad mercury switch is clamp-mounted on the shaft operating the safety dogs. The switch is connected in parallel with the cage pull switch and the hoisting engineer is notified instantly in the event of slack rope.

(3) A pull switch is mounted above the skip bottom dump door as accompanying photo shows. Opening and closing of the door actuates the pull switch through the chain and brass spring linkage. A basket to receive the slack chain as the door opens is attached to the upper center of the door. Tension of the spring should be adjusted so that an inch or two opening of the door will be indicated on the panel in the hoist room.

Signals to the hoist engineer from the pull switch, or in the event of slack rope, are auditory. A 6-in. permanent magnet speaker is actuated through a relay and emits a loud ac 60-cycle hum. This signal is clearly distinct from the shaft and station signals which are single stroke and vibratory gongs. The opening and closing of the skip bottom dump door is indicated to the hoist engineer by a pilot light situated next to the dump pilot light on the spot pointer. This pilot light is also controlled through a relay.

Avoid Overloading Conductors

It is advisable to limit the current in the conductors when used with a 115v ac power supply. This can be accomplished by use of relays and over current releases. One of the three conductors is grounded at both ends in the hoisting rope caps and serves as a common ground for the other two electric conductors.

Due to capacitance of the well insulated conductors embedded within the hoist rope, a slight pull can be noted on the relay armature when the conductor is charged. The pull can be controlled by a capacitor working in series with the relay operating coil. A 1 mfd capacitor with the 115v relay in use with a 1⅝-in. hoisting rope 4,000 ft long works satisfactorily at the Galena mine. Details are shown in accompanying circuit diagram.

Some thought was given to 115v dc power. This would eliminate the inductance created by an ac power supply but would necessitate the maintenance of a rectifier. The ac system was selected for its simplicity. Care should be taken at all times not to overload the conductors as their small current carrying capacity will not take sustained overload without failure in a short time.

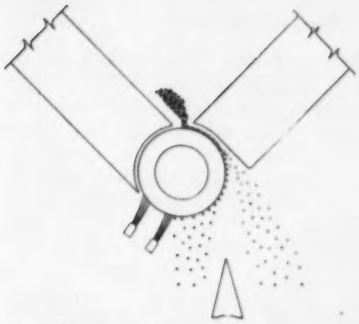
Maintenance Eliminated

Now that the wired hoisting rope installation is complete at the Galena mine and has been in service for the past 6 months, the electrical department is relieved of much extra work connected with maintenance of the electronic signalling device such as changing batteries at least three times a week, along with constant maintenance of transmitters and receivers.

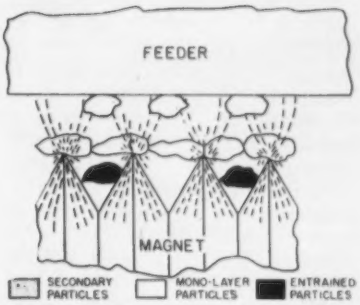
Hoist engineers are much happier. There's no worry of muck spilling into the shaft from an accidentally opened door on the skip, and emergency signals from the cage are completely reliable.

Additional hoisting rope is on order to place in service when replacements are required. Similar wired ropes will go in all our deep shafts where positive communication from moving cage is needed. The use of telephone instead of bell signals between the cage and hoisting deck was not put in practice because of safety reasons.

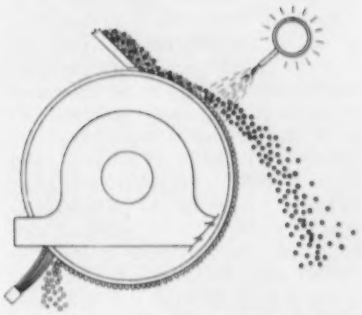
These Steps Hold the Keys to the Process



1. **TREAT** roasted sand on magnetic separator to make magnetic fraction.



PERLMAN'S patented tooled-roll design should be considered and tried.



2. **THEN** process non-magnetic material with high tension electrostatics.

How To Process Alluvial Sand For Tantalum-Columbium

J. E. SHELTON

W. A. STICKNEY

A COMBINATION of gravity, magnetic and high-tension electrostatic separation, is a potential means of producing a tantalum-columbium concentrate from alluvial sand, according to tests conducted here at Northwest Electrodevelopment Laboratory, U. S. Bureau of Mines, Albany, Ore.

In addition, these tests show that (1) radioactivity of euxenite offers a method of detection for operational control; (2) attrition scrubbing is important in cleaning mineral surfaces for physical separation; and (3) heat-treating the sand results in cleaner separations with magnetic and high-tension forces by effecting changes on the mineral surfaces.

Method Proved on Sand From Bear Valley

In efforts to develop a beneficiation procedure, laboratory studies were made by the Bureau of Mines at Albany, Ore., on a sample of dredge concentrates from the Bear Valley, Idaho, alluvial sand deposits. Representative portions of the sample analyzed by quantitative X-ray spectrographic and chemical methods for columbium and tantalum, showed that the material contained 0.61% columbium pentoxide and less than 0.5% tantalum pentoxide (below the limit for accurate determinations).

Mr. Shelton and Mr. Stickney are with U. S. Department of Interior, Bureau of Mines, Northwest Electrodevelopment Laboratory, Albany, Ore.

Petrographic examination showed the sample was a complex mixture of 23 minerals. It contained magnetite, titaniferous magnetite, and minor quantities of ilmenite, garnet, quartz, feldspar, hornblende, allanite, biotite, epidote, limonite, hematite, sericite, euxenite and ilmenorutile. The latter two are the principal columbium-tantalum-bearing minerals. We saw only trace amounts of columbite and monazite.

Other samples from Bear Valley show that one area might contain essentially monazite, with smaller amounts of magnetite and ilmenite, while another area might be almost all ilmenite.

Attrition Scrubbed to Clean

The surfaces of many of the minerals were iron-stained, which would alter their response to magnetic forces or electrostatic separation—a surface phenomenon. As a preliminary step in all testwork, minerals were attrition scrubbed at 80% solids to clean the surfaces.

Since examination of the black sand showed magnetite and titaniferous magnetite as major constituents, their removal was necessary to prevent masking of high-intensity magnetic separations and interference in electrostatic separations. The Crockett wet magnetic separator and Davis tube both were effective in removing these highly magnetic minerals.

Most strategic minerals in the nonmagnetic fraction from the low-intensity wet magnetic separation are susceptible to magnetic forces of higher intensity. Simplest procedure in attempting to separate these minerals appeared to be sizing on 28- and 48-mesh screens and treating the separate size fractions on the ring-type separator. We passed nonmagnetic fraction at one intensity across the ring separator at higher intensities. This process also showed relative magnetic susceptibilities of the minerals.

We examined each product under a binocular microscope to evaluate the results of the concentrating procedure during testwork and to familiarize laboratory personnel with physical appearance of the minerals. But, columbium-tantalum-bearing minerals closely resemble each other and are so similar in appearance to many other minerals that microscopic identification was unsuccessful. Identification of the minerals is difficult, even for a trained petrographer, and accurate only with the petrographic microscope.

Using the Geiger Counter

Euxenite, as the principal columbium-tantalum-bearing mineral, is highly radioactive and there was a possibility of tracing its path with a geiger counter during testwork. Ilmenorutile, essentially nonradioactive, had similar magnetic and high-tension properties and reported with the euxenite minerals. Therefore, the radioactivity of each product was recorded using a 64-scaler geiger counter. We observed that, by correlation between the $(Cb, Ta)_2O_5$ analysis and radioactivity of each product, a reasonably accurate estimate could be made of the

content of any particular ingredient.

Results of a simple magnetic separation scheme showed that about 30% of the (Cb, Ta)$_2$O$_5$ could be recovered as 4.55% concentrate of combined magnetic products. A petrographic examination was made to determine the mineral types and amounts. We found that intensities high enough for complete separation of ilmenite, also attracted garnet, columbite, and some euxenite. Lowering the intensity to separate a clean ilmenite product contaminated the euxenite-ilmenorutile product with ilmenite and garnet, as well as gangue minerals that had equal magnetic susceptibility.

Removing the Ilmenite

Roasting of the ilmenite was used to increase its susceptibility to a magnetic force (we found that heat treatment did not affect euxenite or ilmenorutile). A sample of sands was treated first by removing the magnetite and titaniferous magnetite. Then, a ring-type magnetic separator set at 2.8 amp, with a ⅜-in. air-gap spacing, was used to remove a clean ilmenite product.

Next the nonmagnetic fraction was roasted for 2 hr at 1,472 deg F in an electrically heated muffle furnace. Repassing roasted product over the ring separator at the same intensity produced an ilmenite and garnet product free from euxenite. Analyses showed that recovery of (Cb, Ta)$_2$O$_5$ was increased to approximately 50% in a 4.12% concentrate.

Passing the concentrate over a shaking table to further upgrade this material raised the grade to 9.6% but over-all recovery was only 15.33%.

Results up to this point showed that magnetic separation and tabling of this complex ore were not adequate to produce a high-grade (Cb, Ta)$_2$O$_5$ product with good recovery. Closeness of magnetic susceptibility and specific gravities prohibited clean separations.

Turning to Electrostatics

Since magnetic or gravity separations combined with roasting was ineffective, we tried electrostatic separation.

In general, electrostatic separation uses a charged field with little or no current flow and attracts particles of one charge toward an electrode of the opposite charge.

High-tension separation, on the other hand, uses a very high rate of discharge with electron flow and gaseous ionization playing a major part. Minerals passing through the field are sprayed with a high-voltage discharge, giving them a high surface charge that will cause them to be attracted to a grounded rotor.

Half of the Oxides Stay With Ilmenite

Product	Weight per cent	Analyses, per cent			Distribution per cent (Cb, Ta)$_2$O$_5$
		Cb_2O_5	Ta_2O_5	(Cb, Ta)$_2$O$_5$	
Slimes	3.23	0.6	<0.5		
Magnetite	43.85	<0.2	<0.5		
Ilmenite	44.68	0.2	0.4	0.6	43.25
Conductor					
Ilmenite	0.92	1.5	<0.5		
Euxenite-ilmenorutile	1.12	24.0	2.4	26.4	47.69
Nonmagnetic	0.77	2.3	<0.5		
Nonconductor					
Garnet	0.22	1.2	<0.5		
Table conc	0.24	9.6	1.3	10.9	4.25
Table tail	1.34	1.4	<0.5		
Nonmagnetic	3.63	1.0	<0.5		
	100.00				

Minerals Contain These Elements

	Per cent Cb_2O_5	Per cent Ta_2O_5	Per cent U	Per cent Th
Euxenite	24.0	2.0	15.0	5.8
Ilmenorutile	18.0	11.0		
Columbite	58.0	14.0		
Ilmenite	0.32	0.8		

Minerals with a relatively high conductivity readily lose this charge and are thrown from the grounded rotor, while minerals with low conductivity are attracted and pinned to the rotor. These tests were made with a high-tension-type separator, because both electrostatic and high-tension separations could be made.

Roasting Aids Separation

Preliminary tests were made on euxenite-rich products from previous tests. The electrostatic forces tried did not make the desired separations, and time did not permit further investigation into the many possible voltage variables.

Samples of unroasted material were tested by high-tension separation at an output of 20,000v, with an air-gap spacing of sufficient distance to prevent arcing. Euxenite and ilmenorutile acted as semi-conductors and reported in both conductor and nonconductor fractions. Repassing each fraction to produce cleaner products resulted in resplitting the euxenite. Even increasing the output to 30,000v did not make any noticeable change in separation.

Pretreatment of the sample with HCl or benzoic acid changed the mineral surfaces and their response to an electric field. Separation tests on roasted sample showed that roasting had also altered the mineral surface, making euxenite a conductor to the high-tension forces.

These tests showed that roasting had a two-fold purpose: (1) Increasing magnetic susceptibility of ilmenite and garnet and (2) making euxenite and ilmenorutile respond as conductors to high-tension forces.

Since roasting was an important factor in the beneficiation procedure, we had to determine the optimum temperature for surface alteration. Four heat tests were conducted on samples from which the magnetite, titaniferous magnetite, and ilmenite had been removed with temperatures varying from 129 to 1,832 deg F. Roasting at 1,832 deg F nodulized the sand, making mechanical separation impossible. Each of the other roasted products was treated on the high-tension separator set at 20,000v.

Conductor fractions were sized and each fraction separately passed across the ring-type separator set at 2.8 amp. Concentrate from the 1,292 deg F roast contained 44.6% of the (Cb, Ta)$_2$O$_5$, with an analysis of 19.3%. Concentrate made from the 1,472 deg F roast had a grade of 26.5% (Cb, Ta)$_2$O$_5$ and recovered 45.8% of the combined oxides. A concentrate with a grade of 23.4% at a recovery of 41.9% (Cb, Ta)$_2$O$_5$ was made from the sample roasted at 1,652 deg F.

Checking the Method

Final test was made on a 500-lb sample, incorporating information and observations gleaned from preliminary tests. Sample was attrition-scrubbed, and deslimed; and the magnetite, representing 43.9% of the weight, was removed by the Crockett wet magnetic

separator. Then an ilmenite product representing 44.7% of the weight was removed on a ring-type magnetic separator.

The nonmagnetic fraction was roasted at 1,472 deg F for 2 hr and then treated on the high-tension separator. Conductor fraction was passed across the ring separator at 2.8 amp, and the nonmagnetic fraction repassed at 3.5 amp. Columbium-tantalum-rich product had an analysis of 26.4% $(Cb, Ta)_2O_5$ and contained 47.7% of the $(Cb, Ta)_2O_5$.

Total Recovery Is 85%

None of the tests had shown recoveries of over 50% of the combined oxides in the euxenite-ilmenorutile concentrates; and 43% of the oxides was in the ilmenite product, which had a grade of 0.60% $(Cb, Ta)_2O_5$. Grain counts of each product showed that approximately 85% of the columbium-tantalum-bearing minerals was present in the final concentrate.

The ilmenite product contained a minor amount of columbite, but not of sufficient quantity to account for a grade of 0.6%.

A hand-picked sample of the ilmenite mineral was examined by X-ray analysis. It was found to contain 0.32% CB_2O_5 and 0.8% Ta_2O_5, indicating that treatment methods other than physical would be required to recover all of the $(Cb, Ta)_2O_5$.

Nonconductor fraction contained most of the unrecovered discrete minerals and was re-treated by magnetic separation of the same intensities as the conductor fraction.

The magnetic fraction containing $(Cb, Ta)_2O_5$ was tabled to separate the minerals with specific gravities lower than euxenite and ilmenorutile. This concentrate recovered an additional 4.25% of $(Cb, Ta)_2O_5$ at a grade of 10.9%. A continuous process would permit the return of this product to the circuit at the head of the high-tension separator.

We examined samples of hand-picked columbium-tantalum-bearing minerals for Cb_2O_5 and Ta_2O_5.

Studies were not made at this time to recover other minerals, such as monazite, ilmenite, or garnet, since our primary objective was to recover columbium and tantalum. Columbite was present in only trace amounts, and a sufficient quantity of a columbite-bearing magnetic product was not collected for detailed study.

Testing Cascade, Idaho, Black Sands

Bear Valley deposit contains a measurable amount of columbium and tantalum, and we found a beneficiation procedure to be helpful in recovering a marketable product. At Cascade, Idaho, another alluvial sand deposit was being processed by magnetic means to recover monazite. One of the byproducts of this operation is a rougher ilmenite concentrate, which is being stockpiled for possible re-treatment pending development of a market.

Examinations of this ilmenite product had shown traces of black, radioactive minerals. Because of the small amount present, accurate identification of the minerals or determinations of the mineral content could not be made, and the columbium-tantalum content of this product was below the limits of quantitative analysis. Owing to the interest in columbium-tantalum-bearing minerals, we were requested to treat a sample of the ilmenite concentrate as an aid in evaluation and to determine to what extent the minerals could be concentrated.

The high ratio of concentration required made it necessary to treat a larger amount of material than could be handled by laboratory equipment. Arrangements were made with Porter Bros. Corp., Boise, Idaho, to treat a 2500-lb sample in their pilot plant. Procedure was to follow the method we used on Bear Valley black sands.

Pilot Plant Run

The 2500-lb sample was attrition-scrubbed and deslimed. Low-intensity magnetic separation removed a finished magnetic fraction that weighed 17.5 lb. Then, the nonmagnetic product was treated on an 18-in. induced roll separator to remove the ilmenite. Each product was recycled for cleaning.

Nonmagnetic product from the induced roll, weighing 322.5 lb, was roasted at 265 deg F before high-tension separation at a positive setting of 26,000v, using a beam-type electrode. Both conductor and nonconductor products were recycled for cleaning to remove a high-grade monazite concentrate, which weighed 15 lb.

The conductor product, containing ilmenite, some garnet, quartz and monazite, and the columbium-tantalum-bearing minerals, was passed across the crossbelt magnetic separator. Seven magnetic products were removed (in the usual treatment procedure they are stockpiled for further treatment). The final nonmagnetic fraction, containing the columbium-tantalum-bearing minerals, weighed only 35.45 oz.

For further upgrading, the nonmagnetic material was treated by hydraulic classification and tabling. Normally, the table concentrate would be a final product, but the small amount of material available did not permit making a clean, high-grade concentrate of the columbium-tantalum-bearing minerals. Therefore the table concentrate was re-treated on the high-tension separator.

The nonconductor fraction weighed 6.17 oz and contained only minor amounts of strategic minerals. Conductor fraction weighed 8.43 oz and assayed 36% $(Cb, Ta)_2O_5$.

Testwork shows that electrostatic and magnetic separation may be used as an aid in evaluating deposits as to mineral content and economic value. The importance of accurate identification and product analysis cannot be overemphasized when considering techniques to be used or grade of products made. Results of these tests also show that a concentration ratio of 4800:1 is necessary to produce a product of saleable grade.

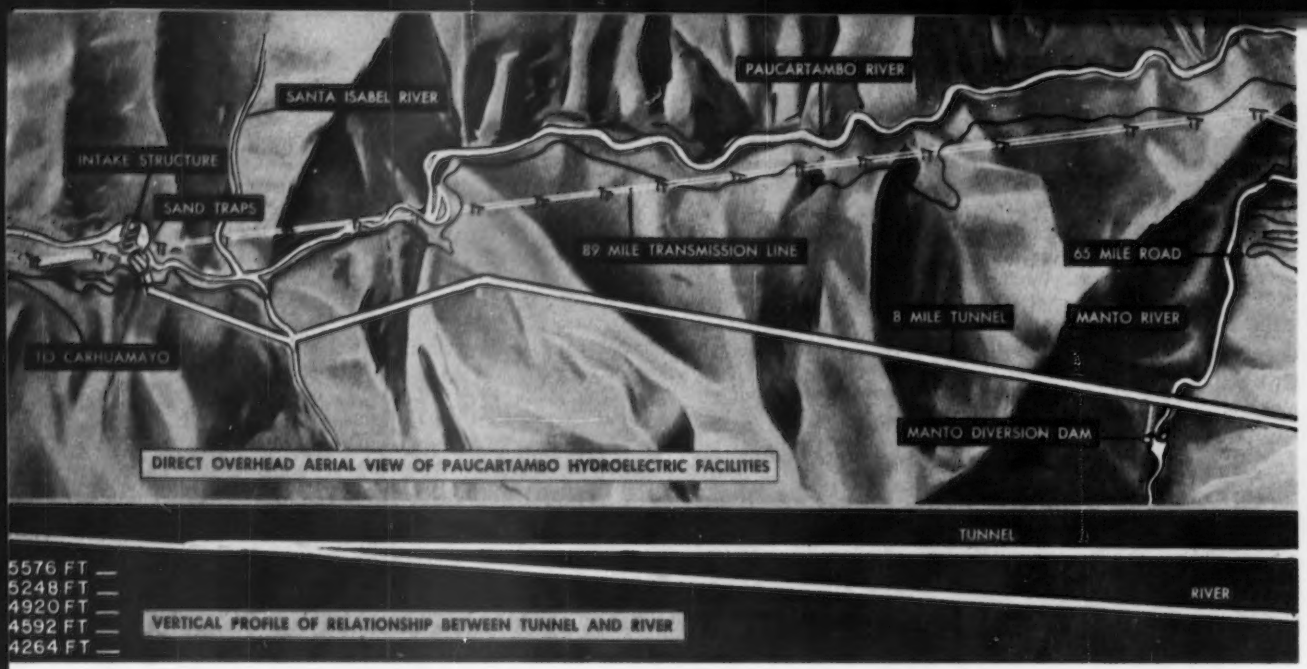
Petrographic examination of the concentrate showed that it contained euxenite and ilmenorutile, a mineral not previously found in this area. Questions were raised as to whether ilmenorutile was a distinct mineral or an intergrowth of ilmenite and rutile. Closer examination and X-ray analysis of hand-picked samples showed that it was a separate and distinct mineral.

Columbium's Importance Stressed

Columbium and tantalum are vital to the defense program. Columbium is a necessary constituent of many high-temperature alloys and heat- and corrosion-resistant stainless steel. These alloys find use in the screaming jets that patrol our skies. And, special properties of tantalum make it useful in electronic equipment in these same planes.

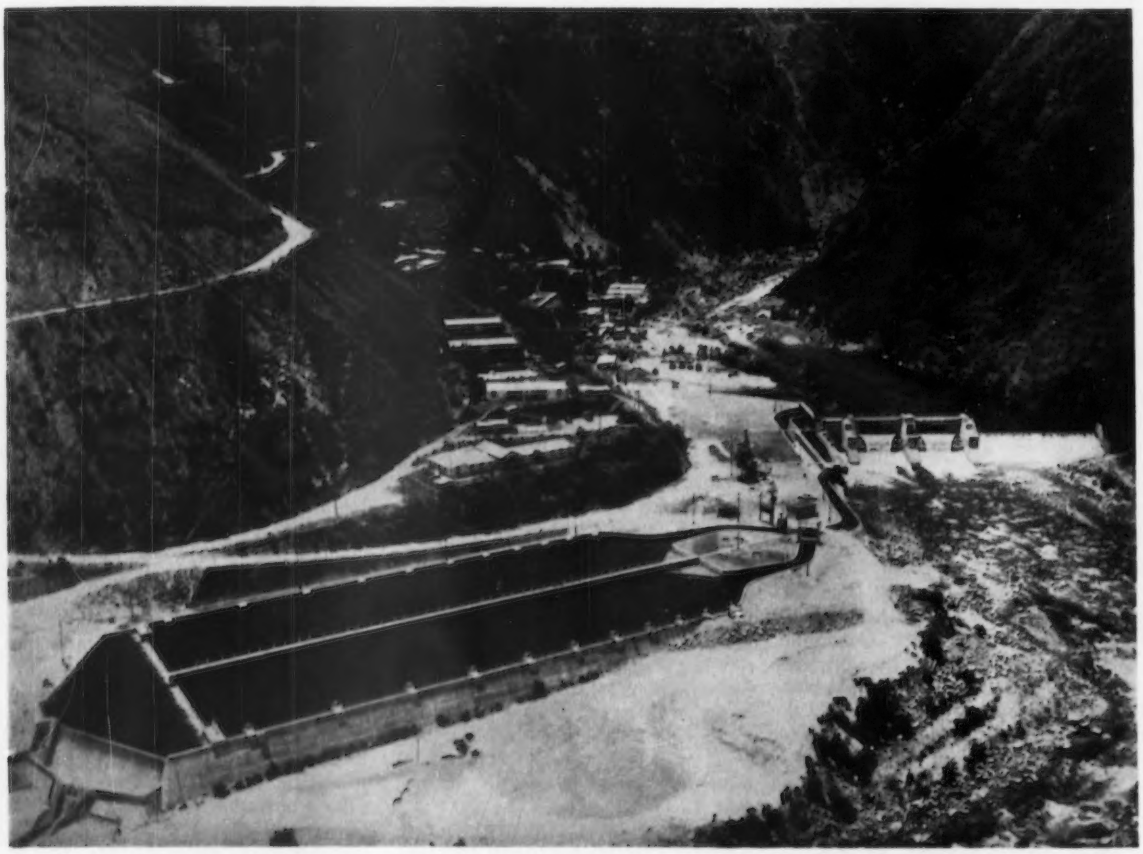
The search for radioactive minerals has led to re-examination of alluvial sand deposits, and the presence of minerals bearing columbium and tantalum, as well as uranium, thorium, rare-earth oxides, ilmenite, and zirconium, has been noted. As a result, prospecting and treating alluvial sand deposits for gold have become secondary in importance.

In the past, the United States has depended upon foreign sources for these two metals. Vagaries of world conditions have made it imperative to develop a domestic supply that can meet the ever-increasing need. Large low-grade deposits of alluvial sands offer a potential source, but a method of concentrating the columbium-tantalum-bearing minerals has to be found. Perhaps this method will point the way.

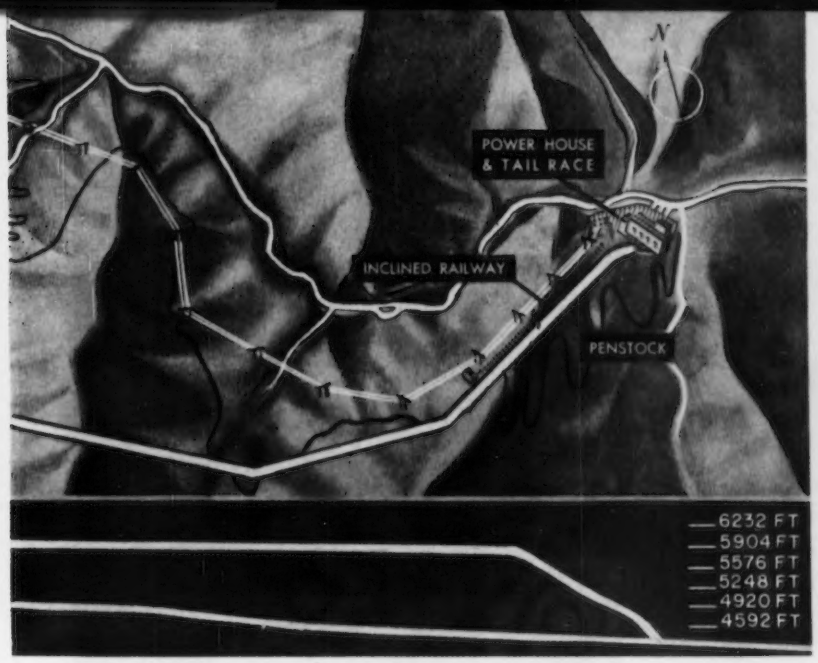


EIGHT-MILE TUNNEL carries Paucartambo River waters to penstocks at Yaupi to create 72,000 kva additional power for

Cerro de Pasco Opens $25-Million



THE TURBULENT PAUCARTAMBO is harnessed at Yuncan's 230-ft dam and partially channeled into the dual-basin trap and forebay (lower left). Dam has 130-ft free spillway and two 50-ft tainter gates on the controlled spillway section.



Cerro's facilities. The 65-mile access road tries to follow the transmission line.

Specifications

Turbines—Three, horizontal, single overhung double-jet, impulse type—450 rpm, 28,000 hp at 180 cfs, 1,580 ft net effective head.
Maximum hp—31,000.

Generators—Three, 24,000 kva, 0.9 pf, 21,600 kw, 13,800v, 3-phase 60-cycle, 450 rpm.

Penstock—3,750 ft long exclusive of steel liner, manifold and distributing sections. Inside dia ranges from 79 to 71 in.

Tunnel—40,800 ft long exclusive of cut and cover and steel liner section. 61%, or 24,900 ft, is concrete lined.

Static head—1,730 ft.

Dam—260 ft over-all length with two gates, 50x16 ft.

Sand Traps—Two, 90x350 ft.

Powerhouse—40 ft wide, 213 ft long. 46 ft high.

Substations—One 13.8 kv to 138 kv; two 138 kv to 50 kv.

Hydroelectric Project

A. W. KNOERR

IN PERU, when you push a button at an inaugural ceremony, something has to happen, or the audience will be disappointed. So when the three inaugural speakers, Robert Koenig, president of Cerro de Pasco Corp., Sr. Victor Ricaldi Chacca, power plant foreman, and Sr. Ingo Carlos A. Alzamora, Minister of Public Works, pushed buttons simultaneously at the inaugural ceremony of the Paucartambo power project at Yaupi Bajo on March 17, a horn sounded. The blast was followed by a roar as the pelton wheel of a generator responded to powerful 8-in. jet streams at the base of the 3800-ft penstock. In a few seconds the generator quieted to a smooth hum, sending thousands of kilowatts to feed the large power network in the Peruvian Altiplano which makes Cerro's growing metal production possible.

Mr. Koenig told the audience that the $25-million power installation and $5-million highway project were "tangible proof that when human and material resources are joined with modern technology, nature's frontiers can be made to give way in the interest of economic and social betterment."

Subsequent addresses by Peruvian officials underscored the fact that free enterprise, with engineering and capital resources, operating in a favorable investment climate made huge projects like Paucartambo a reality.

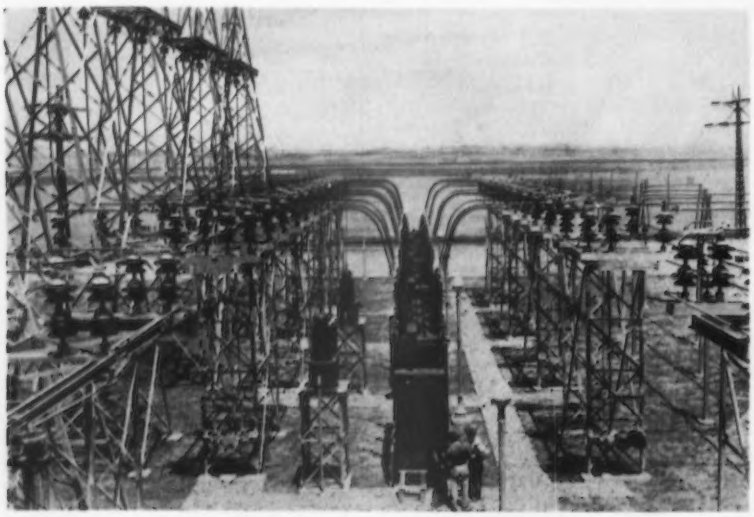
Without Paucartambo, Cerro's expanding metal production would suffer a bottleneck of power insufficiency. Production of copper, lead and zinc was about 150-million lb seven years ago. Now it is approaching 350-million lb per year. In the future it is expected to rise to about 450-million lb. This increased metal output has to be matched with additional power which Paucartambo now offers.

With the addition of Paucartambo power, Cerro will now be able to proc-

POWERHOUSE and substation at Yaupi Bajo are constructed to permit expansion to 100,000 kva if warranted. Three generators are in operation at the present time.

WATER PLUNGES down the 3800-ft penstock from tunnel exit at Yaupi Alto to the generators some 1500 ft below.

CONCRETE FLOORED TUNNEL average diameter 13 ft, is completely lined for over 61% of its length to fight bad ground.



INTERMEDIATE POINT on the 89-mile transmission line from Yaupi Bajo to La Oroya is Carhuamayo substation. Line carries 138,000v over rugged terrain.

ess all of the low grade zinc concentrates produced by the company. Heretofore nearly all such concentrates had to be stockpiled during periods of low zinc metal prices.

Paucartambo's drainage system receives its water from westbound saturated air currents rising from the Amazonian jungle. The rainy season is months longer than that in the Junin basin which supplies most of Cerro's present water supply. Thus Paucartambo's generators can pick up the bulk of the power load in periods of high run-off while the reservoirs at Junin and elsewhere are allowed to fill up to capacity.

Addition of a fourth generator and development of small storage areas at the headwaters of the Paucartambo area will increase capacity of the plant from 72,000 kva to 100,000 kva.

Much of the terrain traversed by the highway and power line is so steep that you can "spit a mile" according to the men who supervised the project. How the workers ever dug the post holes for the power line and strung the conductor wires defies imagination. At times highway workers suspended by ropes had to hand chip a few square feet of horizontal area before they could set up a jackhammer

Corona losses of the three 138,000v high-altitude transmission lines are low because they are widely spaced and constructed of steel reinforced 477,000-circular mil aluminum cable. Two overhead ⅜-in. high-strength galvanized steel cables connected at frequent intervals to a No. 4 iron counterpoise cable buried beneath the power line reduce interruption by lightning despite the very high incidence of electric storms in the area.

Cerro's Paucartambo project is located at about 6,000 ft above sea level on the eastern slope of the Peruvian Andes, about 90 miles from Oroya. A dam has been constructed at Yuncan, in the Paucartambo Valley to control the turbulent waters which originate high in the Andean lakes.

Dam proper is 230 ft across, with a 130-ft free spillway and a controlled spillway equipped with two steel 50-ft tainter gates. Below the gates the water enters a curved canal which is

LANDSLIDES AND VICIOUS SLOPES hampered construction of the 65-mile access road built along the 568-tower power line. Line is aluminum.

connected to a dual-basin sand trap. A forebay, see photo below, regulates flow of water to the tunnel.

Tunnel is horseshoe shaped, runs 8 miles from the Yuncan dam to the outlet at Yaupi Alto, and has an average diameter of 13 ft. Nearly 25,000 ft of the tunnel had to be concrete lined as drifters encountered numerous fault zones containing badly fractured and broken rock and ground waters. Entire tunnel floor was concreted as well, to improve hydraulics and for simplified cleaning. At the height of construction, when a total of some 4,000 men were employed overall on the project, the tunnel was being driven on six faces.

Mean rate of flow in Paucartambo's principal tunnel is 4 fps at the present time. A step-up to 6.5 fps is indicated, and provided for, if the number of generators at the Yaupi Bajo power station should be increased from the present three to five.

As a further protection against loss of power during the dry season (Cerro lost some production in 1956, when rainfall in the central Sierra region was abnormally low) water can also be diverted into the main tunnel from the Manto River by means of a concrete arch dam, diversion tunnel and connecting raise. Similar plans are being studied for the Santa Isabel River, which could be diverted into the pond behind the Yuncan dam.

Emerging from the main tunnel at Yaupi Alto is the 3800-ft penstock, which conveys the water to the powerhouse at Yaupi Bajo. Penstock, supplied by Bethlehem Steel Corp. in 30-ft sections, has an outside diameter of about 7 ft. It penetrates some 300 ft into the tunnel outlet, where it is equipped with a butterfly valve protected by a surge chamber.

An average angle of 25 deg is maintained by the penstock as it pitches down the mountainside to the powerhouse 1500 ft below. There it branches out to three tubes, each supplying a single turbine.

Paralleling the penstock is one of the world's shortest, slowest and steepest rail routes. The inclined railway which was used for penstock erection and for lowering heavy equipment to the powerhouse has a maximum gradient of 50%.

The 72,000 kva (87,000 hp) powerhouse, located on the right bank of the Paucartambo 11 miles downstream from the Yuncan dam, is built of reinforced concrete and measures 213x40 ft. It houses three Westinghouse generators, each rated 24,000 kva at 0.9 power factor. Generators are driven by three S. Morgan Smith turbines. The powerhouse, like the tunnel has provisions for expansion to four, or maybe five, generating units instead of the current three. Possible maximum capacity would then be over 100,000 kva. Also at Yaupi Bajo are three main step-up transformers, a modern machine shop and housing for operating personnel.

High Power—High Up

Transmission lines run a total of 42 miles over the rugged terrain between Yaupi Bajo and Carhuamayo and another 47 miles to Oroya and Cerro's smelter. Carrying 138,000v, the line is believed to be the first of such tension installed at altitudes above 12,000 ft.

The line is supported by 568 towers of two, three and five wooden pole construction. Some of the deep passes which confronted the construction crews were conquered by shooting a rope across with a Lyle gun. One span, across the Manto River Valley, stretches 3,720 ft.

CdeP engineers conducted studies which revealed that incidence of lightning in the Peruvian Andes is among the highest in the world. To lower structural footing resistance and increase lightning protection, they buried counterpoise wires for the length of the transmission line.

Two new substations, at Carhuamayo and Oroya, have been installed in addition to the main step-up transformers at Yaupi Bajo.

Initial engineering surveys were, a Cerro spokesman says, "tests of endurance." Flies were numerous, the rainy season turned trails to mud and streams to raging torrents, and vampire bats played havoc with horses and mules.

But Yaupi Bajo, down at 4,000 ft in the forested foothills of the Paucartambo Valley, may become a popular recreation and vacation spot for Cerro employees. A 12-room hotel, dining hall, residences and other facilities have already been constructed there and, if future plans materialize, this newest community in eastern Peru may grow even more as vacationing employees from "The Hill" enjoy the contrast to their own lofty residences.

Conceivably, the whole area may enjoy a population growth with the opening of the new road. Its previous remoteness, according to the company, is illustrated by the owner of a small hacienda, a lifelong resident of the area who, at the age of 70, reported seeing his first motor vehicle.

What were once fertile terraces of the ancient Incan empire border many stretches of the road. Outside the town of Paucartambo, the road passes the remains of an Incan fortress commanding approaches to three valleys.

A New Look

REGISTRATION of over 3700 was a new high for meetings outside New York.

TECHNICAL SESSIONS were packed. This crowd was for Pelletizing session.

WELCOMING LUNCH was one of 51 functions other than the technical sessions.

MORE THAN 3700 mining and oil people attending the annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers in New Orleans from Feb. 24 to 28. made it the largest Institute meeting ever held outside of New York.

Those in New Orleans for the meeting put in long days (there were 350 papers read in the four days) and long nights—a smoker Monday; an informal dance on the river boat, President, Tuesday; the annual banquet Wednesday. And there was always a jazz-filled, nightclub-lined Bourbon St. beckoning.

Of prime interest was the reorganization of the Institute, a move started three years ago. Individual awards went to 16 men and two petroleum sections won the prizes for the greatest proportional growth during 1956.

No attempt can be made to summarize the 350 sessions, but here's a brief run down of meeting highlights and observations with a few grab samples from the technical program.

New reorganization and operating plans for the American Institute of Mining, Metallurgical and Petroleum Engineers were set in motion at the New Orleans meeting when the Board of Directors formally adopted new by-laws and rules.

Under the new plan the National AIME will be composed of three separate societies with individual by-laws and officers: The Metallurgical Society; the Society of Mining Engineers; and the Society of Petroleum Engineers. Activities and affairs of the three member societies will be subject to authority of the Board of Directors of the National AIME, and all member societies will have adequate representation on this board.

This drastic reorganization required much planning and extra effort on the part of past AIME presidents, Drew Fletcher, H. DeWitt Smith, Leo Reinartz, Carl Reistle, and their associates on the Board as well as more recent work by the 1957-58 president Grover Holt.

Because of the huge membership of the AIME and the great diversity of regional and technical interests formulation of radically new by-laws was not easy. Rights of individuals and local sections had to be preserved, and yet the Institute affairs had to be managed and run by responsible officers and directors on a business-like basis with year-end financial statements in the black. The smoothness with which this transition is being

for AIME at New Orleans

brought about is a great credit to the administrative abilities of AIME officers, directors, and members who worked out the reorganization.

Grover J. Holt, general manager of the ore department of Cleveland-Cliffs Iron Co. took over the reins of the AIME presidency from Carl E. Reistle Jr., (See cover) vice president of Humble Oil & Refining Co. Dr. August B. Kinzel, vice president of Union Carbide & Carbon Co. was installed as president-elect for 1958.

New AIME headquarters was a subject of nationwide interest with the announcement that progress had been made in establishing future headquarters for the five engineering societies in New York City. Task forces reported that location of the headquarters at the present 39th St. site would not be feasible. New sites in the Mid-Town area of New York City are being investigated and a committee is expected to report on a new location soon.

The American Society of Chemical Engineers has been invited to become an active member of the United Engineering Trust which is responsible for the headquarters project, and the Chemical society has accepted.

In 87 years of the Institute's history, this was the first meeting in New Orleans. If the majority of those attending 1957's Crescent City get-together have any say, it won't be the last meeting in New Orleans. In fact there was a strong ground swell developing in support of a move to hold future AIME meetings in New Orleans, San Francisco and New York exclusively.

Audience participation at technical sessions brought out a wealth of useful information. At a shaft-sinking session T. N. Williamson presented a paper on "Large Diameter Mine Shafts by Rotary Drilling" which covered conventional methods in review, and a technique developed by Zeni Corp. which involves the use of Hughes roller bits on the cutting edge of a 6-ft diameter steel cylinder. See *E&MJ* Guidebook, June 1956, p 95. Questions from the audience ran about like this:

Roger Pierce: Will it be possible to build a drilling machine as big as (7) or (8) ft in diameter?

Williamson: There is some talk about an 8-ft machine, and it is definitely in the picture.

Lee Barrett (Joy Mfg. Co.): We are building an 8-ft dia machine for the Zeni company, but it won't be ready until later this year.

Query: Is the 10-ft per cutter a good bit life?

Williamson: The bit cost of $7 to $8 per foot drilled is not too high for a large-diameter hole.

Query: Have you experienced any deviation in the hole?

Williamson: Some, but it's been so small that it's hard to measure.

Besides 350 papers there were 51 luncheons, dinners and other events on the program. Only competition was from some of the nation's finest restaurants only a stone's throw away. In the refueling and refreshment department, however, MBD's Scotch Breakfast is still in a class by itself.

Evan Just, in his paper, "Foreign Private Investment—A Boon to Developing Countries," stated that many countries sorely in need of development, do little to attract foreign private capital, the only source of rapid and dependable industrial progress. They often have false notions about foreign exploitation or domination or are so nationalistic they refuse assistance. Mr. Just defined conditions which encourage investment by foreign capital in under-developed countries:

1. An opportunity to earn a profit.
2. Control of the operation.
3. The right to sell the product in free markets.
4. The right to bring home profits and to amortize the investment.
5. Freedom from burdensome taxation.
6. Freedom from artificial impediments to trade.
7. Freedom from import duties on needed goods not produced in the country.
8. Non-discriminatory legal treatment.
9. Reasonable political stability.

Mayor DeLesseps Morrison made the Welcoming Luncheon the sprightliest in years. Along with the official welcome and a few broadsides at Texas mythology, the Mayor gave Carl Reistle the Key to the City. His Honor mentioned that he once gave the Key to Gene Autry's horse which had been led right up to the Mayor's desk. "First time," said Mr. Morrison in reference to some of his predecessors, "We ever had a *whole* horse in the Mayor's office."

GROVER J. HOLT, AIME's president for the coming year.

A promising trend was the associate chairmanship of two meetings by ladies; Katherine Mather of Jackson, Miss., and Pauline K. Moyd of Yonkers, N. Y. Both ladies are geologists and married to geologists.

Mohamed Mortada earned the enviable distinction of winning two awards for his paper, "A Practical Method for Treating Oilfield Interference In Water-Drive Reservoirs." This was the first paper ever submitted for publication by the chemical engineering graduate of the University of Cairo.

Medals and Honors

Herbert Hoover Jr.
Hoover Medal

Andrew Fletcher
Rand Medal

John E. Brantley
Lucas Gold Medal

Russel B. Caples
James Douglas Medal

Leo F. Reinartz
Benjamin F. Fairless Award

Dr. Arthur Tix
Robert W. Hunt Award

Raymond W. Sundquist
J. E. Johnson Jr. Award

Mohamed Mortada
Rossiter W. Raymond Memorial Award

Paul Gordon
Mathewson Gold Medal

Dr. Antoine M. Gaudin
Robert H. Richards Award

Louis A. Panek
Robert Peele Award

Joseph L. Gilson
Jackling Award

Mohamed Mortada
Alfred Noble Prize

Raymond C. Bell, Gordon H. Turner, Ernest Peters
Extractive Metallurgy Award

Camp Bodie: 1903

Being an account of mining and mining men; travels, talks and high-grading among the Cousin Jacks in one of the toughest of the old camps. Told by *E&MJ*'s favorite chronicler, Atha Albert Richie, of Rialto, Calif.

I WENT OUT OF TONOPAH on a six-horse stage to Sodaville and from there to Hawthorne on the narrow gage. I was really an unsophisticated kid when I went to the office in Hawthorne to buy a ticket on the four-horse stage to Bodie.

The stage was leaving just about sundown and it was late enough to be rather cool of nights at that elevation. A fellow came out of the stage office and climbed up on the boot with the driver, and I, being more willing to talk than to listen, said to him, "You had better come inside. It will be pretty cold out there before morning."

"Oh, I think I'll stay out here tonight," he said, "I like the fresh air." In another few minutes two men carrying an iron box with two padlocks on it came out and handed it and a sawed-off shotgun up into the boot. I at once realized that I had opened my mouth too wide again.

We picked up my bedroll at Ben Rosenthal's hotel and Mr. Rosenthal told me I'd be riding to Bodie with the superintendent of the mine, Mr. Hoover, I am quite certain this was Tad Hoover, the brother of the ex-President.

A Good Way to Learn

Mr. Hoover asked me where I had come from, and then why I had left Tonopah to go to Bodie, and I told him that I had been mining about three years and that I wanted to be a good miner and to work in different camps to see how things were done in different places. He said, "Well, that's a good way to learn, but there is nothing to be learned in Bodie that you could not learn better in Tonopah."

I will say, however, that I did learn quite a lot about working in a very wet shaft — something I couldn't have learned in Tonopah at that time. Afterwards, when Tonopah got down to water level I worked as a pump man there for a considerable length of time.

I was around Bodie for four or five days when I went to work as a shaft man at an old property 25 miles from town called Castle Peak. The foreman told us that it was really wet and that the water was just about as cold as any could be. He sure did not overstate the case.

All the work in the bottom was being done with double hand hammers, and if a fellow was sitting down turning a drill and that water falling on him, his hands would get so cold and numb that I remember going into the boarding house to supper and I could not cut my meat—the knife would turn over in my hand. If I happened to be hammering, of course I was plenty warm.

The water came out of the hanging wall about 18 or 20 ft up, in big streams. We used to put a big bunch of waste in our hats to cushion the shock. When we blasted we pulled the suction hose up in the shaft and we would go back and put it on just as soon as we could stand the smoke. On many occasions we were bolting the suction hose underwater, it rose up so fast. The pump was a No. 9 Cameron, run by steam.

The foreman was a Cousin Jack and his wife was the cook. It was there that I got acquainted with Cousin Jack pasty. On day shift we came up and ate in the boarding house, but on night shift we carried a lunch and the boarding Mrs. would quite frequently make a pasty for each of us. On those occasions it would be a lunch and a real lunch if ever I had one.

The engineer would put the pasties in a tub and turn steam on them. The hoist man used to say, "I like they wen theys 'ot, but I don't give a damn for they wen theys cold."

Bodie was one of the last strongholds of the Cousin Jacks and if they were not in the majority, there was at least a preponderance of them. I was going along the street when a woman called to a bunch of little boys playing a game we called "shinney on your own side" when I was back in Wyoming. I said, "Boys, your mother is calling you." One of them looked at me in a contemptuous manner and said, "Er isn't calling to us, us doesn't belong to she."

I met a school teacher there from my home town in Wyoming and she told me about the three little girls who lived next door who ran various errands for her. She always paid them a nickel or a dime and was very careful to take turns when she needed their service. One day she called one of the girls to run to the store and one of the other sisters stepped forward. "Er doesn't belong to go this time! I belong to go this time." My teacher friend was trying to school them in English.

Bodie was one of the toughest of the old camps and there was a saying that they killed a man every morning before breakfast for the first 15 years of the town's existence. The Bad Men from Bodie were gone when I got there and I do not believe that there was a single man killed in Bodie during the time I was there.

Over the Hill

When Castle Peak closed, I walked over the hill seven or eight miles to the old camp of the May Lundy mine. The mine was up on a hill, about 11,000 ft I believe. They had a kind of change house at the adit to the tunnel and the mine was as cold and wet as Castle Peak had been. As the men came out of the tunnel the foreman gave each a glass of Jesse Moore whiskey: the company bought it by the barrel. I'm wondering if any other mining company has followed this practice.

When I got back to Bodie, I had two checks from the Castle Peak mine on the Jim Cane National Bank of Bodie. When the bank cashed my checks I just happened to notice that the amount was several dollars short. The cashier told me that had been the custom for many years because the stage was held up so many times that all the checks were discounted at the bank. I got my checks back and cashed them at Reno for face value.

Bodie was said to be one of the great high-grading camps. Some say the miners eventually high-graded more than $1-million. The old timers there told me it had stopped long ago, but one of them showed me three specimens of his that were real pop-eye picture rock. I'd say there was three or four times as much gold as rock in the specimens. Pretty stuff.

Mr. Richie has not forgotten his way with a hammer and drill. In the photo above two grandsons and their mother witness an exhibition.

WHAT'S NEW IN U.S. PATENTS

OLIVER S. NORTH

Mining

Cryderman mucking machine. Design for an improved shaft mucking machine having a cage from which is suspended a telescoping boom with a clam on its free end. Apparatus is particularly adapted for mucking inclined shafts. W. L. Cryderman, assigned to Shaft Machines Ltd., Toronto, Ontario. No. 2,781,140.

Scooping apparatus for mines shafts. This shaft excavating apparatus comprises a bucket supported on a frame and operating means that allow for sufficient manipulation to clean, widen and deepen existing shafts. R. C. Sights. No. 2,781,926.

Method of defining excavation limits by fixing subterranean markings to delimit the boundaries or portions of an orebody which it is desired to excavate. Holes are drilled and plugged with low-cost, readily available and easily distinguishable material to indicate to advancing miners the limits of excavations. Cheap, earthy materials of distinctive colors are used for packing holes. R. J. Hundhausen, with one-half interest assigned to D. W. Butner. No. 2,782,759.

Ore Dressing

An improved method and apparatus for separating and recovering mineral components of black sand, beach sand or the like. Mechanism can be mounted on a barge. Sand is pumped through series of tanks having splitters for separating the various fractions. E. A. Hobart, assigned to Hobart Brothers Co., Troy, Ohio. No. 2,780,356.

Rugged jig apparatus especially suitable for beneficiating hematite, limonite and taconite ores having a particle size range from one inch down to 325 mesh. C. H. Remer. No. 2,781,129.

An improved method for dewatering finely divided ore concentrates, for example, those from a previous dressing treatment. Slurry is rendered hydrophobic and then centrifuged. W. Reerink, W. Müschenborn and E. Nötzold. No. 2,781,904.

An improved method of beneficiating phosphate rock, sylvanite or the like by electrostatic means. Provision is made for promptly and entirely removing separated particles from the field once they have migrated to a field of the correct charge. C. C. Cook Jr. and J. E. Lawver, assigned to International Minerals & Chemical Corp. No. 2,782,923.

Continuous centrifugal ore concentrator. A simple, inexpensive, improved centrifugal ore concentrator which can be operated continuously. Heavy particles collect in rotating bowls having a network of channels rather than the usual mesh. Clogging of the mesh is thus avoided. Zirconium ores are satisfactorily beneficiated in this apparatus. W. N. T. Morton. No. 2,782,925.

Hydrometallurgy

Selective uranous phosphate precipitation process for recovering uranium from ores, especially those of low-grade assaying less than 0.2% uranium oxide and containing gold, pyrite, heavy minerals and carbonaceous material. D. Kaufman and S. E. Bailey, assigned to Atomic Energy Commission. No. 2,780,519.

COPIES OF U.S. PATENTS can be purchased at 25c each from Commissioner of Patents, Washington 25, D.C.

Carbonation of recycle liquor in sodium sesquicarbonate production. An improved recycle process for recovering sodium carbonate or sodium sesquicarbonate from trona. R. D. Pike and K. B. Ray. No. 2,780,520.

Method of concentrating solutions without evaporation. Metal salts, including those of copper, nickel, manganese and lithium, may be concentrated by heating the metal-containing solution under pressure to a temperature above normal boiling point, removing superanatant liquid as required and recovering the concentrated solution. Expensive and time consuming evaporation steps are avoided by this method. F. A. Schaufelberger, assigned to Chemical Construction Corp. No. 2,780,530.

Uranium recovery process. Sulphuric acid digestion method for processing very low-grade uranium ore and concentrates containing hydroxide precipitates. J. J. Brunner, assigned to Atomic Energy Commission. No. 2,782,091.

An alkaline method for treating monazite. Ore is boiled with sodium hydroxide and then treated with hot water or with a mother liquor recovered from subsequent operation. Insoluble hydroxides thus obtained are washed with dilute sodium hydroxide and further processed to separate the rare earths and thorium and uranium compound. C. de Rohden and M. Peltier, assigned to Societe de Produits Chimques des Terres Rares, Paris, France. No. 2,783,125.

Pyrometallurgy

Process for treating pulverized iron oxides, such as calcined pyrite, oxidic iron ores and the like, with carbon monoxide to produce iron carbide powder, which can be used as a starting material for making iron or iron alloys. P. O. Stelling and I. G. M. Pereswetoff-Morath, (said Pereswetoff-Morath assigned to Stelling, Stockholm, Sweden). No. 2,780,537.

Indirect heat calcining kiln. Design for fluidizing apparatus for heat-treating finely divided fluidizable solid materials, such as flotation tailings, alumina and other metallic carbonate and sulphide ores. A. C. Turney and B. J. Zubrzychi, assigned to F. L. Smidth & Co., New York. No. 2,782,019.

Method of roasting mixtures of copper and sulphidic materials to convert the copper to a soluble form while maintaining or converting associated iron in an insoluble form. This permits subsequent use of leaching methods to separate the copper compounds from residual insolubles. R. M. Foley, Dorr-Oliver, Inc., Stamford, Conn. No. 2,783,141.

Letters

(Continued from p 4)

tain points out. It should have read as follows:

Aerofall mill. East Daggfontein Mines Ltd., South Africa, installed a 17-ft dia mill, predicted from results obtained that an integrated Aerofall mill-gold-cyanide-uranium-leaching program would cut working cost 4.97 shillings per ton (over 10% reduction in over-all cost to mine and mill). In addition, these tests showed that recovery of uranium would go up from 79 to 88.5% and that sulphuric acid use could be cut by 35%.

This test program was the subject of articles in *Canadian Mining Journal*, No. 6, June 1956, p 163; *Mining World*, May 1956, pp 48-52, illus.; and *Mining Magazine*, June 1956, pp 325-334, illustrated. —Ed.

Reserve Taconite

Dear Sir:

Mr. Gilvert Haas of our organization was kind enough to let me read a copy of "Reserve Taconite Project—From Pit to Pellet," an excerpt from *Engineering & Mining Journal*, December 1956. I thoroughly enjoyed reading the article and I believe it is probably one of the best written explanations regarding the taconite industry.

Lennart J. Gran
Osborne & Thurlow
New York 6, New York

Canadian Uranium Producers

Dear Sir:

I wish to draw your attention to several errors in the January 1957 issue of *E&MJ* which pertain to Canadian uran-

(Continued on p 112)

WASHINGTON IMPACT

Highlights

MINING "RETRENCHMENT" AHEAD—Domestic mining is heading for an economic shakedown. Washington Government economists say they see no cataclysmic depression for the metal and mineral industries, but a top Interior Department official puts it this way:

"It would be foolish to deny that a general retrenchment is coming. It may not show up for some months or even two or three years, and it won't affect all mined commodities. But a good number of mines are going to have to shut down."

THE BEARS' CASE—A pessimist can make a convincing case out of these straws in the wind:

1. Government support purchases. A budget-conscious Congress is reluctant to sign any new checks for Government support purchases of domestic metals and minerals.

2. Stockpiling. Another wartime program fast running out, stockpiling also has been "cut off at the pockets" by the House, which slashed 1958 budget funds from $130-million to $19-million and then wiped out the remaining $19-million. If the cut sticks, the program is virtually at an end.

3. Tax aid. Expansion goals, for which fast amortization may be granted, have been closed for chemical grade chromite, manganese, and selenium. This leaves mercury, nickel, and synthetic mica, which may soon be closed also.

4. Tariffs. Protectionists' hope for new tariff restrictions on foreign competition through the new "defense essentiality" clause dimmed when defense mobilizer Arthur Flemming ruled against domestic cordage producers in the first such test case.

5. Capital investment. A new survey by Commerce Department and the Securities and Exchange Commission shows that as an industry mining plans to spend a total of $1.2-billion, 2% less than last year, on expansion of plants and equipment this year. All other industries, except public utilities and commercial services, plan to spend more during 1957 than they laid out last year.

THE BULLS' HOPES—On the other hand, brighter spots in the economic sum don't make headlines.

Both the Administration and Congress are basically friendly to the mining industries. Interior Department now says it will have its long-range support program ready for Congress in another month. Unless it costs the Government substantial money out of pocket, Congress is expected to at least try to help keep domestic mines open wherever possible on a sound economic basis—at least with technical research and development aids.

The whole trade agreements program will get a thorough Congressional review this fall, and even liberal traders admit that a rising protectionist sentiment in Congress may push through selective tariff hikes or possibly some new quotas.

New mobilization requirements and policies, hammered out by the Defense Department and ODM, are geared to the military new look, featuring new light metals.

WHERE IT WILL HURT—The Interior official who adds up all the factors and sees a general retrenchment translates it in these terms:

Large, established producers of basic commodities may have to cut back, but won't suffer too much. The Government has said it will continue buying lead and zinc. Copper producers will have to tighten their belts but can count on steadying markets. Iron is tied to the steel boom. The light, atomic metals have bright prospects of new markets. Tungsten figures to suffer the most if the stopgap purchase funds are denied.

"Production has been running at new record levels each year, reflecting both wartime demands and artificial Government stimuli. Now that both are running out, it is a question of adjusting production schedules, to normal peacetime demands."

Trade Policy Battle Expected in Early 1958

FOREIGN TRADE POLICY battle lines in Washington are being drawn cautiously and thoroughly on Capitol Hill. The big fight will come during the first session of Congress next year, when the whole framework of Reciprocal Trade Agreements and tariffs is up for extension. But protectionists and liberal trade proponents are marshalling their arguments already. Groundwork significant to the metals and minerals industries is shaping up in these areas:

1. Reciprocal trade laws. Basic legislative authority for over-all U. S. trade policy runs out in June 1958. The House Ways & Means Committee handles this legislation, and its foreign trade subcommittee headed by Rep. Hale Boggs (D-La.) is the primary forum. Boggs' group has just completed extensive hearings on tariff, customs and trade policies, and announced a full schedule of study for the coming months.

Boggs, a liberal trader, is opposed to any basic change in the nation's trade policy. However, his subcommittee is inviting all views from all sources. The committee will collect compendia from representatives of various industries, economists, and Government spokesmen, then hold panel discussions and finally more hearings on these papers. Boggs' final document will serve as a sort of encyclopedia of existing trade law and proposed changes, containing the cases for and against amendments to the laws.

2. Anti-dumping. One of the first battlegrounds for the trade fight will center around the anti-dumping laws, which are up for extension this year. Treasury Department, as administrator of these laws, has sent Congress its proposed technical amendments. But the real fight is expected over proposals to remove present requirements that domestic industries show damage before foreign imports of any given commodity are banned under these laws—and proposals changing the formula under which Treasury determines the "fair value" price limit below which foreign goods may not be sold. Many bills already have been introduced embodying these two changes. Protectionists and liberal traders are preparing their arguments to testify on these bills shortly.

3. U. S. membership in OTC. The White House is behind a new bill authorizing the U. S. to join the proposed Organization for Trade Cooperation, an international administrating body to police reciprocal tariff and customs agreements. Proponents argue that OTC will protect domestic exporters more than favor foreign imports, by assuring concessions granted the U. S. through GATT (General Agreements on Tariffs and Trade.) A similar bill died in Congress

last year, but the climate is regarded as more favorable this year, though the authorization is no sure bet.

4. Defense essentiality. One of the newer trade law provisions sure to get a review from the Senate as well as the House this year is section 7, the amendment tacked on last year's Trade Agreements Act extension in Congress, which allows Office of Defense Mobilization to hear domestic producers' complaints that foreign imports are endangering national security. If ODM agrees, it may recommend tariff or quota relief to the White House.

Liberal traders have feared this new path to tariff relief could provide an easier means of restricting international trade than the escape clause and peril point relief administered by the Tariff Commission, sometimes on the same grounds of defense essentiality. There's a move to force ODM to set up specific standards defining what is a defense essential industry.

However, ODM's first ruling on a section 7 appeal, by domestic cordage producers, set a pattern which places the burden of proof on the petitioner.

5. Quotas. Quota bills crop up every Congressional session, and this year is no exception. Specific quota restrictions will be considered in the over-all trade legislation review, and even liberal traders admit some industries may be able to make strong enough cases to get some approved.

Rising protectionist sentiment in Congress already has made itself felt, and will be evident in the battle over the above issues. But it has also spurred liberal trade proponents to prepare for the fight, and the White House is committed to generally liberal trade policies. No sweeping changes in the nation's trade policy is anticipated as a result of the Congressional fight. But some specific domestic producers may win new concessions and protective relief.

Foreign Aid Quarrels

EFFECTS OF FOREIGN AID on mining are explored in a special report to the Senate, prepared by the National Planning Association, research groups and leading public officials and scholars. The report's general conclusion is that 10 years of foreign aid has "made contributions toward increasing both U. S. and world supplies of our natural resource materials," and at the same time, assuming a dynamic and expanding world economy, "it is difficult to see how foreign aid, even if doubled, could have a serious impact on the availability or price of natural resources."

In sum, the report concludes, the impact of foreign aid on domestic resources "is not sufficiently large to base a decision on the future of foreign aid policies" on that impact.

Labor This Month

MINE-MILL SINGS HAPPY TUNE: At the 52nd convention of the Mine-Mill and Smelter Workers Union, its officials painted a rosy picture of the year just over—and the year ahead. Despite its legal troubles with the Government and the courts, the non-ferrous mine union claims hefty advances in wages, services for its members, greater political influence, successful organizing and so on.

While some of the statements made by leaders of the 64-year-old union may be on the optimistic side, they can point to some figures when it comes to wages and resisting raids of their membership. The three-year contracts which Mine-Mill is now operating total a sizeable $1,500 advance for the workers, according to union figures. And, National Labor Relations Board election results show, Mine-Mill says, "consistent defeat of attempts by other unions (particularly the Steelworkers) to raid Mine-Mill's jurisdiction both in the U. S. and Canada."

THE ROAD AHEAD—A BUSY ONE: That's the plan of MMSW leaders who have extensive projects for the rest of 1957. With no bargaining scheduled for the year, these officers have as project number one a national health and welfare program. The idea is to put over a Federal law that would set minimum standards and then press at contract reopening time for boosting these standards.

Too, on the legislative side, Mine-Mill is pressing for new safety legislation that would help to hold down such diseases as silicosis. The union is being supported in this campaign by Montana Congressman Lee Metcalf who led the schedule of guest speakers at the union convention. Also on tap at the convention on the same subject of safety was John A. Johnson, chief of the division of safety of the USBM.

Despite facing a closed door at AFL-CIO headquarters, Mine-Mill will renew its efforts to join the merged labor movement this year. It's like battling a windmill, but the non-ferrous union will continue to make overtures for joining the alliance—and will continue to get the cold shoulder.

TEAMSTERS COUNTER-FIRE AT MINE-MILL: Officials of the International Brotherhood of Teamsters, facing racketeering charges before Senate investigators, denied a one-time alliance with MMSW to support a claim of clean operations. Frank W. Brewster, west coast Teamster official accused of being involved in rackets and misuse of union funds, gave a break-up of the Mine-Mill pact with the Teamsters as part of his defense.

Brewster cited this example to the investigating committee as evidence of "strong convictions" of the union against Communism.

Brewster's explanation didn't cover another detail of the dissolution of the pact. The Mine-Mill-Teamster deal was made just at the time of the AFL-CIO merger convention late in 1955. When federation president George Meany and other officials heard about it, they demanded it be cancelled. At that time, these officials were under the impression that the pressure did the trick. Brewster reports it differently.

PRODUCTIVITY—A BARGAINING WEAPON: In the next few months there'll be a continuing battle over productivity—and how much it's climbing. With just about everybody agreed that wage increases are directly related to the increase in worker output, the question is how to estimate the advance. Labor, management and the Government don't see eye-to-eye on this. The battle is just getting under way.

Highlights From The Annual Reports

Sharon Steel Corp. reported that Mallory-Sharon Titanium Corp. tripled titanium ingot production over 1955 level and shipped four times as much mill product as in the previous year. New melting furnace is nearing completion, with first of five vacuum melting furnaces installed and the rest to be in by spring.

Plant expansion cost $5-million. Plant will have the largest vacuum annealing furnace of its kind. Facilities to recover pure titanium from scrap will be in operation by late 1957. Mallory-Sharon expects to ship 3,000 tons of mill product in 1957 (more than entire national output in 1955).

Atlas Titanium Ltd., Welland, Canada, completed its first year of operation.

Reactive Metals, Inc., formed by Mallory-Sharon with National Distillers Products Corp. is constructing a zirconium melting plant at Ashtabula, Ohio.

Inland Steel Co. had net income of $52,998,726 from its entire operation. Total steel making capacity is now 5.5-million tons. Three new 315-ton open hearth furnaces with combined 800,000 annual tons are under construction at Indiana Harbor and will give Inland 6.3-million ton ingot capacity by 1958. Sintering plant at Indiana Harbor will be expanded and completed by 1959, increasing their pig iron capacity 300,000 tpy. $65,739,121 was added to investment.

Caland Ore Co., Ltd. continues to dredge Steep Rock Lake, Ontario. Lake level has been lowered 150 ft. Project is on schedule and will deliver first ore in 1960.

Indiana Harbor plant received 1,343,693 tons from company mines and 2,589,066 tons from affiliated companies. First pellets from Marquette Iron Mining Co. (20% Inland Steel Co.) were received in 1956. Marquette will double present production by 1959.

Anaconda Co.'s recent stock prospectus states the following copper ore reserves:

Location	Millions of tons and grade
Greater Butte	
above, 3,400 level	180 at 1%
Berkeley Pit	100 at 0.8%
Yerington	
oxide	40 at 0.8%
sulphide	25 at 0.9%
Chuquicamata	
oxide	120 at 1.32%
mixed oxide-sulphide	25 at 2.25%
sulphide	450 at 1.63%
sulphide below present pit level	375 at 1.73%
below this level	(undetermined)
El Salvador	300 at 1.6%
La Africana	3 at 2.25%
Greene Cananea	77 at 0.8%
Total	1,695,000,000

This total represents approximately 23% of the known Free World's copper reserves.

Also, Anaconda states that zinc reserves in Butte are 6,317,000 tons, 8.45% Zn and 3.52 oz Ag. Smelter produces about 25% of the U. S. primary electrolytic zinc output.

Uranium reserves in the Jackpile are reported at 15-million tons, 0.16% U_3O_8 and it is estimated that 5.5-million tons, 0.18% U_3O_8 can be mined and treated before March 31, 1962.

Anaconda will pilot an aluminum from clay process. The company holds extensive clay reserves near Moscow, Idaho.

Anaconda produces about 85-million lb of lead annually.

American Brass will spend $70-million over the next five years on expansion.

M. A. Hanna Co. consolidated net income for 1956 was $19,491,884, an increase of 25% over 1955 figure. During the season approximately 27-million tons were shipped—Hanna mines in the U. S. shipped 13-million; Lake Superior district shipped 2-million; and Quebec-Labrador fields responded with 12-million tons. The 27 Hanna operated mines in Lake Superior district, Minnesota and Missouri produced about the same amount as in 1955. Hunner mine started shipping (800,000 tons in 1956).

Iron Ore Co. of Canada completed French and Gill mines to make four producers and will complete the Ferriman No. 1 in 1957.

Nickel smelter at Riddle, Oregon, was expanded to its planned capacity. Total of 11.4-million lb were produced in 1956. Hanna continued to do exploration work through Mineracao Hanna do Brasil, Ltda.; and Holannah Mines Ltd. continued to drill iron, copper and nickel sulphides in the Ungava Peninsula.

Bateman Bay Mining Co. is operating 12 diamond drills from the ice in Dore Lake and hopes to continue to do the same until mid-April. No tonnage data has been compiled. No decision on shaft sinking will be made until present drill campaign is completed.

Basic Inc. showed a new income from all its refractory operations of $1,721,274 in 1956. Basic's dolomite reserves in Northwestern Ohio are sufficient for company's needs for next 100 years and Basic holds large magnesite reserves in Nevada.

La Luz Mines Ltd. had positive reserves of 5,542,000 tons, 0.115 oz gold and possible reserves of 377,000 tons, 0.13 oz gold, after treating 689,055 tons for an operating profit of $665,230. Capital expenditures amounted to $919,005. Roast-leach process has been developed in the laboratory to handle both the sulphide and oxide copper ores at Rosita whose ore reserves are 3,582,000 tons, 2.9% Cu and 200,000 tons, 5% Cu.

American Nepheline Ltd. had net operating profit of $310,380 and ore reserves of 1,500,000 tons (indicated) and 5,077,500 tons (assured) after breaking and treating 233,124 tons to get 168,487 tons of production. Capital expenditures in 1956 were $1,496,444.

United States Steel Corp. spent $311.8-million on capital improvements and authorized at year end $775-million after an income of $348.1-million.

Manganese mine at the Bolivian border in Brazil is under construction.

Total U. S. Steel iron ore production in 1956 was 47.2-million tons. Oliver Iron Mining division shipped 33.8-million tons (30 to U. S. Steel).

Orinoco Mining Co. delivered 9.1-million tons (6.2 to U. S. Steel).

Total production of fluxing stone by U. S. Steel was 28.6-million tons.

Olin Mathieson Chemical Corp's new division for the production of nuclear fuels was established in 1956. Olin will also build a $36-million chemical fuels plant at the Lake Ontario Ordinance Works, near Niagara Falls, N. Y.

Ground was broken on an aluminum fabricating plant at Omal, Ohio, to cost $70-million. And a primary aluminum smelter will be built at Omal by Olin and Revere Copper & Brass Inc. Total capitalization of $231-million has been made for this project—180,000 annual tons.

International Nickel Co. had net earnings in 1956 of $96,296,000 from 286-million lb nickel delivered and 271-million lb copper delivered plus precious metals and iron ore. Snow tractors are pushing material and equipment into new Manitoba nickel discovery at Moak-Mystery Lakes. This will be a plus $175-million project. Capital expenditure by Inco in 1957 will be $50-million, as against $23-million in 1956.

Other metal deliveries included: platinum group—371,000 oz and iron ore pellets from the one-year old pyrrhotite pelletizing plant at Copper Cliff. Total nickel ore mined was 15,511,000 tons.

Report estimated total free world nickel production at 450-million lb (286 of this by Inco). Total Inco production by 1961 will be estimated 385-million lb.

Ore reserves, exclusive of Manitoba, are 264,224,000 tons.

During the year a 6,000 ton concentrator was placed under construction at Levack. Canadian Industries Ltd. (CIL) is building a sulphuric acid plant at Copper Cliff. Inco has made arrangements with Texas Gulf Sulphur Co. to build and operate an elemental sulphur production plant at the Cliff.

Freeport Sulphur Co. completed pilot plant runs on Cuban nickel-cobalt ore and is making preparations for a project to produce 50-million lb a year. Ore will be leached at Moa Bay by sulphuric acid method, then shipped in empty, returning sulphur boats to Louisiana for metal recovery. National Potash Co., joint venture with Pittsburgh Consolidated Coal Co., went onstream at Carlsbad, N. M.

(Continued on page 214)

CONVEYOR BELTS

9 long years—over 12 million long tons

AND STILL GOING STRONG!

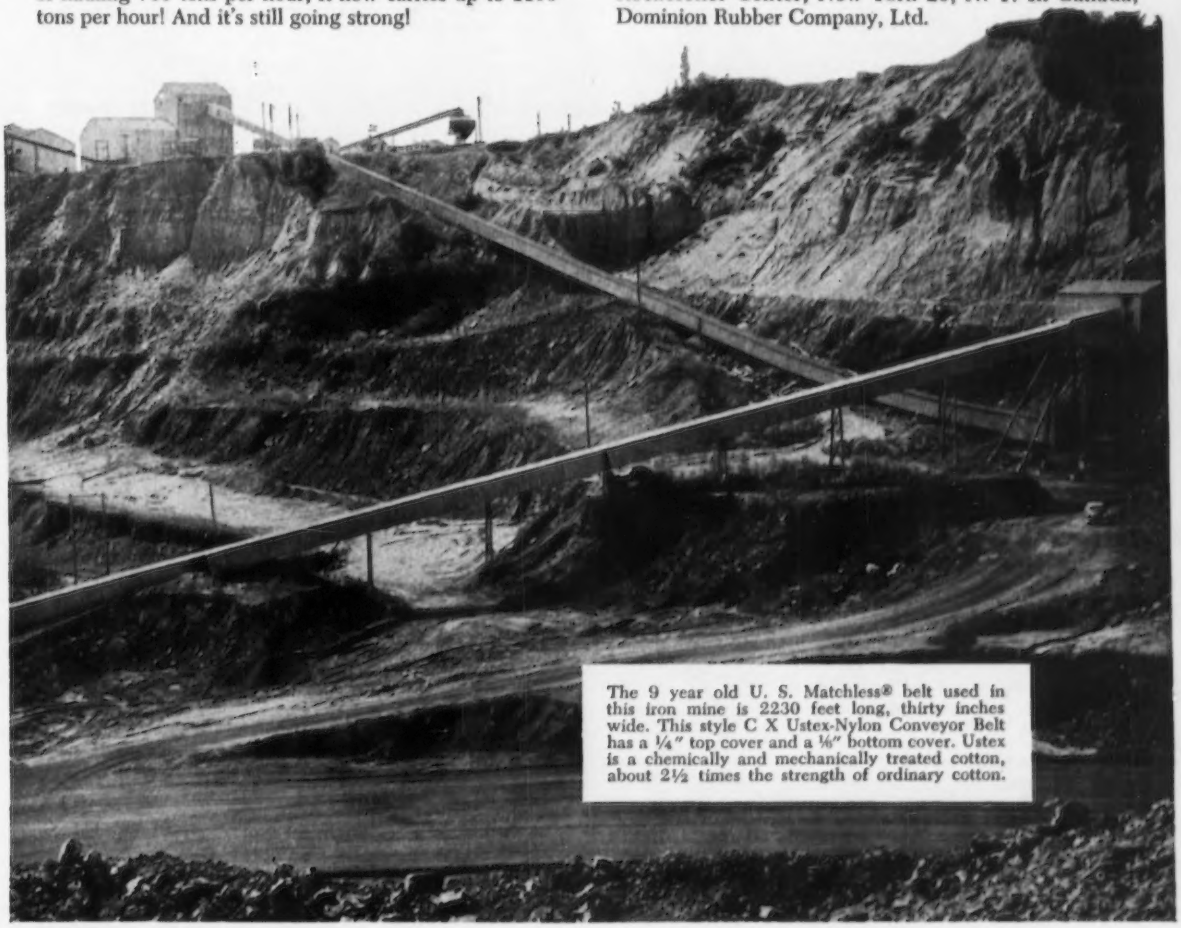
Back in March, 1948, "U. S." installed the first Ustex-Nylon Conveyor Belt ever used in an iron mine. That was 9 years—and over 12,000,000 long tons—ago.

Today, this belt not only is still performing up to expectation, but is actually hauling *many more long tons per hour than when it was new.*

Originally designed in two sections to carry 700 long tons, the belt was transferred, three years after its original installation, to another mine of the operating company—a mine that needed stepped-up production. There, this gigantic belt was spliced into a single length and instead of hauling 700 tons per hour, it now carries up to 1100 tons per hour! And it's still going strong!

This patented Ustex-Nylon Conveyor Belt seems almost indestructible, even under the severe battering of iron ore. Made of Ustex for stamina and Nylon for flexibility, it has saved its owners untold dollars in maintenance and replacement costs alone.

For record breaking performance in your mine, ask about U. S. Rubber's Three-Way Engineering, in which our engineers work with conveyor systems engineers and your own engineers. This service, plus a complete line of belts, is available at any of the 28 "U. S." District Offices, or write U. S. Rubber, Mechanical Goods Division, Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Company, Ltd.



The 9 year old U. S. Matchless® belt used in this iron mine is 2230 feet long, thirty inches wide. This style C X Ustex-Nylon Conveyor Belt has a ¼" top cover and a ⅛" bottom cover. Ustex is a chemically and mechanically treated cotton, about 2½ times the strength of ordinary cotton.

Mechanical Goods Division

United States Rubber

PERSONALS

Campbell

McMynn

Dr. Neil Campbell has been named to the newly created position of senior geologist, special projects, Consolidated Mining & Smelting Co. of Canada, Ltd. **J. E. McMynn** was named assistant to the general superintendent of operations at Kimberley, including the Sullivan Mine and concentrator.

Robert M. Haldeman, general manager of Braden Copper Co., has been appointed vice president, with offices in Santiago, Chile. Mr. Haldeman joined the Braden organization in 1941. In 1951 he was appointed assistant to the general manager and the following year was named general superintendent. He advanced to general manager in 1954.

William B. Hall, general manager, has been elected president and general manager of Vitro Uranium Co., division of Vitro Corp. of America. **Richard C. Cole,** assistant general manager, has been elected vice president of the uranium division. Mr. Hall joined Vitro in 1951 as a project engineer and was named general manager of the division in 1954. Prior to joining Vitro in 1954 as plant manager, Mr. Cole was associated with American Smelting & Refining Co. He was named assistant general manager of Vitro in 1955.

Richard E. Whitson Jr., formally affiliated with Dominion Minerals Division of Riverton Lime & Stone Co., Piney River, Va., has been named sales representative of Kyanite Mining Corp., Cullen, Va.

Dr. Frank W. Hurd has been appointed director of research of Union Carbide Nuclear Co. Identified with Union Carbide's activities in the atomic energy field since 1943, Dr. Hurd was named superintendent of research and development, industrial applications, for the company in 1955.

Frank Eichelberger Jr., has been named general manager of Northwest Refining & Chemical Co.'s new $250,000 refining plant in Spokane, Wash. He was formerly associated with his father, **Frank Eichelberger Sr.,** in Frank Eichelberger & Associates and Conjecture Mines.

Sydney Ackermann has been elected president of Royal Uranium Corp. succeeding **George H. Patterson,** resigned. **Aaron Richards** has been named vice president and treasurer; **Peter Anderson** as secretary; and **Mrs. Gail P. Hardin** as assistant secretary and assistant treasurer. **Willana Patterson,** treasurer and director; and **Harvey Durbin** vice president and director, also resigned.

William L. Kendrick has been named general superintendent of Manganese, Inc., succeeding **John S. Anderson,** who resigned to accept a position with Utah Construction Co. Mr. Kendrick joined Manganese Inc. as kiln superintendent in June 1954. He is a graduate of the Minnesota School of Mines.

G. B. Christian, superintendent of American Smelting & Refining Co.'s Frisco Mine, near Wallace, Idaho, until its permanent closure early this year, has been named mine superintendent at the firm's Galena operation. A graduate of the Washington State College school of mines, Mr. Christian has been employed by Asarco since 1945.

Robert F. Pettit has been appointed to the newly created position of chief engineer of American Smelting & Refining Co.'s Northwest mining department A graduate of the New Mexico School of Mines, he had been associate professor of mining engineering at the Missouri School of Mines since 1955. Prior to that he spent four years with the Atomic Energy Commission as a planning engineer at the Los Alamos Laboratory.

Franklin H. Sharp has been named mill superintendent of Sunshine Mining Co. succeeding **Wayne Gould** who resigned early this year to accept a new position with Dow Chemical Co. at Midland, Mich.

A. Y. Bethune, superintendent of the Bunker Hill Co.'s electrolytic zinc plant at Kellogg since 1954, has been named manager of metallurgy for the company, in charge of the zinc plant, the lead smelter and the 3,000-ton concentrator. Mr. Bethune is a graduate of the University of Nevada in metallurgy and has been employed at the zinc plant since 1928. **Walter Schmittroth,** assistant manager for the past two years succeeds Mr. Bethune. **Samuel Keller,** operating superintendent has been named assistant plant manager, and **Douglas Baker,** a research metallurgist, succeeds Mr. Keller.

O'Leary

Tierney

Vincent O'Leary, former mine superintendent of the Mountain Con mine and acting assistant general superintendent of mines, has been appointed assistant general superintendent of mines, the Anaconda Co. **Edward D. Tierney** has been named general superintendent of the Great Falls Reduction Department, succeeding the late **Clarence V. Saylor.** He has been general superintendent of plants for the Chile Exploration Co. at Chuquicamata, Chile.

Suttie

Griffin

John Suttie, former mine foreman and acting mine superintendent at the Mountain Con mine, Anaconda Co., has been promoted to superintendent of Mountain Con. **Dan Griffin** who has been acting mine superintendent of the Lexington mine, has been promoted to superintendent of the Lexington mine.

Officers elected for 1957 at the annual meeting of the Minnesota Section, AIME, include: **John D. Boentje Jr.,** vice president and general manager, Pacific Isle Mining Co., chairman; **Wayne W. Beebe,** superintendent, Oliver Iron Mining Division's Monroe mine, first vice chairman; **Stephen E. Erickson,** beneficiation engineer, M. A. Hanna Co., second vice chairman; **A. C. Borgeson,** chief mining engineer, Snyder Mining Co., third vice chairman. **Norman A. Moberg,** manager of mining engineering, Oliver Iron Mining Div., was re-elected secretary-treasurer.

Percy L. Douglas has been elected a director of Phelps Dodge Corp.

Ralph W. Williams has been appointed vice president and **William R. Whitener** has been named sales manager of Lake Asbestos of Quebec, Ltd., a subsidiary of American Smelting & Refining.

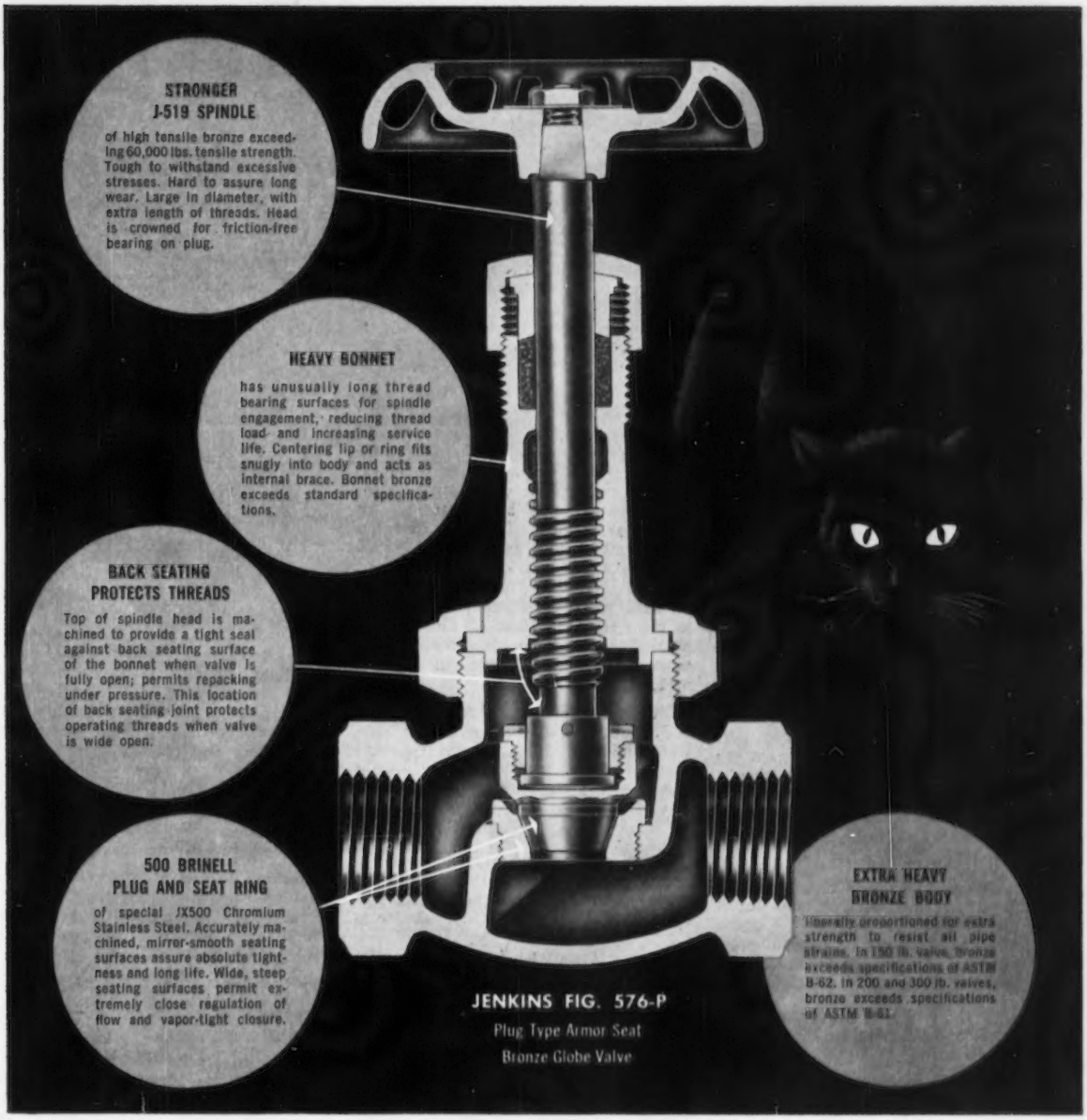
Mario L. Peña, formerly in the sales department, has been transferred to the factory at Dinamita, of Cia. Mexicana de Mecha para Minas, S. A., Mexico, where he will be engaged in production work. **Oscar H. Chávez,** formerly assistant manager of the plant of Cia. Mexicana de Mecha para Minas, S. A., has succeeded Mr. Peña.

Richard C. Annear acting superintendent of Inland Steel Co.'s Greenwood mine, has been appointed superintendent of the property. **R. Donald Tripp** has been named to the newly created position of assistant superintendent of lands.

E. R. Randolph, geologist with the Cleveland-Cliffs Iron Co., has been transferred to their Mesabi Range operations at the main office in Hibbing, Mich.

Leo M. Abell was appointed concentrator superintendent of the Morenci branch, Phelps Dodge Corp., succeeding **J. E. Papin** who retired Jan. 1, 1957.

Where valves need 9 lives...


STRONGER J-519 SPINDLE
of high tensile bronze exceeding 60,000 lbs. tensile strength. Tough to withstand excessive stresses. Hard to assure long wear. Large in diameter, with extra length of threads. Head is crowned for friction-free bearing on plug.
HEAVY BONNET
has unusually long thread bearing surfaces for spindle engagement, reducing thread load and increasing service life. Centering lip or ring fits snugly into body and acts as internal brace. Bonnet bronze exceeds standard specifications.
BACK SEATING PROTECTS THREADS
Top of spindle head is machined to provide a tight seat against back seating surface of the bonnet when valve is fully open; permits repacking under pressure. This location of back seating joint protects operating threads when valve is wide open.
500 BRINELL PLUG AND SEAT RING
of special JX500 Chromium Stainless Steel. Accurately machined, mirror-smooth seating surfaces assure absolute tightness and long life. Wide, steep seating surfaces permit extremely close regulation of flow and vapor-tight closure.
EXTRA HEAVY BRONZE BODY
Liberally proportioned for extra strength to resist all pipe strains. In 150 lb. valve, bronze exceeds specifications of ASTM B-62. In 200 and 300 lb. valves, bronze exceeds specifications of ASTM B-61.
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PERSONALS *(Continued)*

Richardson

Sevensma

James Richardson, formerly directing geological exploration work in southern British Columbia, has been appointed senior geologist for Western exploration, Consolidated Mining & Smelting Co. of Canada, Ltd. **Dr. P. H. Sevensma,** senior geologist at Kimberley since 1951, has been named senior geologist for Eastern exploration for the company.

Mr. Abell was formerly research engineer.

Dr. Horace Thomas of Laramie Wyo., has been appointed to another six-year term as Wyoming state geologist. He is head of the geology department at the University of Wyoming, and has been state geologist since 1945.

Ralph S. Mason, mining engineer with the Oregon state department of geology and mineral industries, has been elected president of the Oregon Technical Council.

John F. Reed, district master mechanic on the Menominee Range for M. A. Hanna Co., has been transferred to Riddle, Ore., where the company has a large nickel property. **Earl Mollard,** formerly with the Hanna Co. in Hibbing, Minn., is manager of the Riddle mine and smelter.

Dr. Richard L. Reddy has joined the staff of the metals research laboratories of Electro Metallurgical Co., Niagara Falls, N. Y., as a research metallurgist. He formerly was a research associate at Rensselaer Polytechnic Institute.

Ralph D. Williams has been named vice president and **William R. Whitener** as sales manager of Lake Asbestos of Quebec, Ltd., a subsidiary of American Smelting & Refining Co.

H. Rush Spedden has been appointed director of research of Union Carbide Ore Co., a division of Union Carbide & Carbon Corp. Since 1952, Mr. Spedden has been in charge of the Minerals Research Department of the corporation's research laboratories at Niagara Falls, N.Y.

A. H. Shoemaker, general manager of Homestake Mining Co., Lead, S. D., has been named chairman of the National Program Committee for the 1957 Metal Mining and Industrial Minerals Convention of the American Mining Congress, held in Salt Lake City, Utah, Sept. 9-12.

W. W. Sieg, president of Titan Metals Mfg. Co., and **Albert S. Redway,** president of Rockbestos Products Corp., have been named vice presidents of Consolidated Coppermines Corp.

Langbourne M. Williams, president of Freeport Sulphur Co., has been elected chairman of the board succeeding **John Hay Whitney,** who resigned Feb. 13 immediately after Senate confirmation of his nomination as Ambassador to the Court of St. James's. Mr. Williams, who has been active in the management of Freeport since 1930, will continue to serve also as president, a position he has filled since 1933.

William D. Jones has been appointed manager of industrial relations of the Toronto, Ohio, plant of Titanium Metals Corp. of America. He was formerly assistant director of personnel and industrial relations with National Lead Co. of Ohio.

Vitro Uranium Co., division of Vitro Corp. of America, has announced the following promotions: **Richard N. Miller,** plant engineer, has been appointed to the new position of assistant to the president and will be responsible for long-range planning. **Leslie D. Lash** has been named senior engineer. He joined Vitro in 1955 as a chemical engineer. **Tony G. Rukavina,** maintenance superintendent since 1952, has been promoted to plant engineer. **Isaac C. Fox,** general maintenance foreman, has been named master mechanic. He joined the division in 1951.

Robert Soderberg, mechanical engineer and maintenance foreman at the Hiawatha mine of M. A. Hanna Co., has been promoted to master mechanic at the Homer mine. **Walter Swanson** has been named underground maintenance mechanic foreman at the Hiawatha.

C. D. Clarke, superintendent of the corporation's Cerro de Pasco mine has been named assistant to the manager of operations—mining, of Cerro de Pasco Corp. (Delaware). **R. M. Humphreys,** superintendent of the Morochocha mine has been named to succeed Mr. Clarke.

Richard Brewer, district engineer for Pickands, Mather & Co. on the Men-

Stephens

Nelson

Claude O. Stephens has been elected president of Texas Gulf Sulphur Co. He was vice president and general manager of production since 1954, and succeeds **Fred M. Nelson,** who became chairman and continues as chief executive officer of the company. **Walter H. Aldridge,** chairman since 1951, has been named chairman emeritus, and continues as a director.

Hood

Kruger

Walter H. Hood has been named manager of the Canadian Flint & Spar Department, International Minerals & Chemical Corp., (Canada) Ltd., succeeding **Norman B. Davis,** who has been named a consultant for IMC. **Dr. Frederick C. Kruger** has been appointed chief geologist for IMC. He was formerly with Reynolds Metal Co. for five years.

ominee Range, has been transferred to the company's general engineering office staff in Duluth, Minn.

David R. Straub, project manager at the White Pine Copper Co., has been elected vice president, general manager and a director of the White Pine Co.

The following organization changes have been announced by the New Jersey Zinc Co.: **R. L. Sayrs** becomes superintendent of the Flat Gap operation at Treadway, Tenn.; **A. C. Savage** has been made mine chief of the Jefferson City, Tenn., property; and **K. R. Winslow** will serve as mine chief of the Austinville, Va., property.

Dr. Wesley O. Connor Jr. of Albuquerque, N. M., has been named secretary of Ranchers Exploration & Development Corp.

Sheldon L. Glover, supervisor of the Division of Mines & Geology, State of Washington, for the past 12 years, has retired after 40 years of professional geologic work.

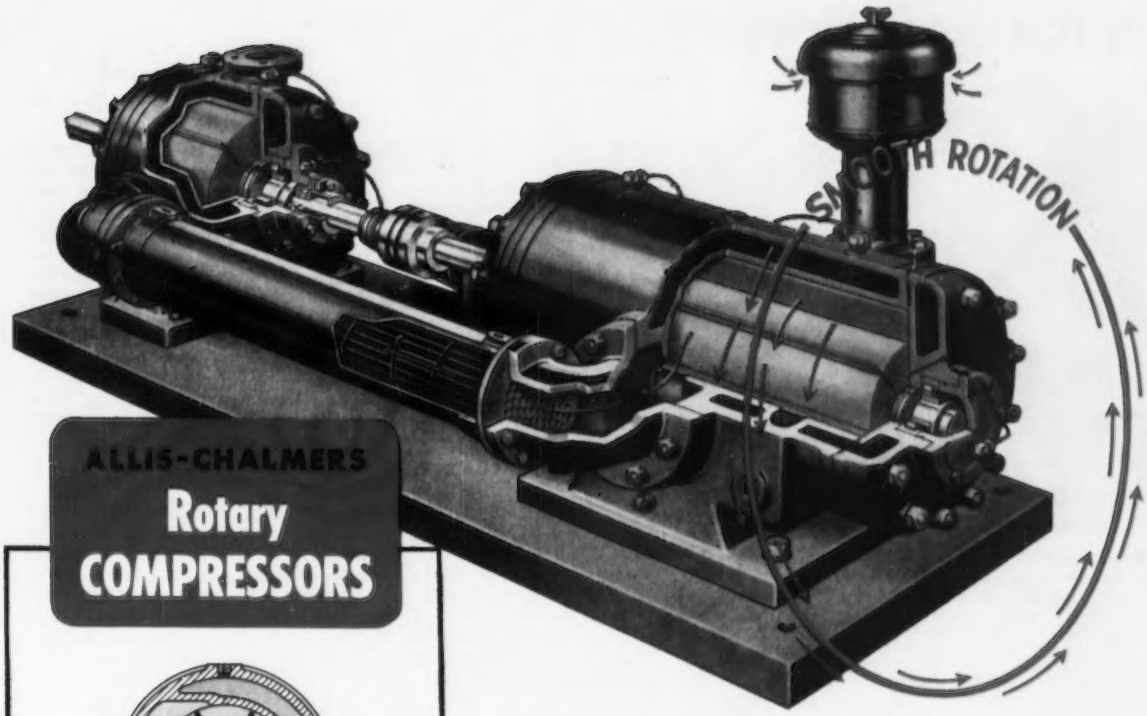
J. A. Sadler has been appointed executive vice president of Rio Canadian Exploration Ltd.

Henry E. Doelle was reelected president of the Chamber of Mines of Eastern British Columbia at the annual meeting in January. He is managing director of Sheep Creek Miners and president of the B. C. Mining Association.

B. O. Brynelsen, Noranda executive, has been named chairman of Vancouver Branch of the Canadian Institute of Mining & Metallurgy succeeding **Ridgeway W. Wilson** who remains branch executive. **Fred H. Stephens** was reelected secretary-treasurer for the 16th consecutive year.

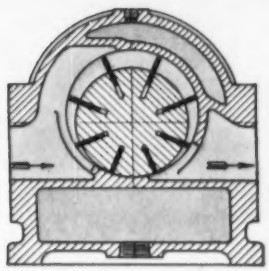
Samuel J. Pisarev has been named a director and secretary-treasurer of the National Tungsten Corp.

Paul E. Finckbone has been named mine foreman for Reserve Mining Co. at the taconite pit at Babbitt, Minn.



ALLIS-CHALMERS

Rotary COMPRESSORS



How *Ro-Flo* units operate: Centrifugal force moves vanes to outside wall to form air chamber.

Smooth-running Ro-Flo Compressors cut vibration, and provide...

Constant Efficiency

YEAR after year there is no change in the efficiency of a *Ro-Flo* compressor.

Efficiency always remains uniformly high even if parts wear. Here's the reason:

During operation the sliding vanes of the rotor (see cross section above) press against the cylinder wall to form air cells. Even if these vanes wear, the centrifugal force holds them in contact with the cylinder wall so that the air cell never changes and efficiency and air flow remain constant.

Rotary Means Smooth Operation

Smooth rotation cuts vibration ... eliminates need for heavy foundations. Small *Ro-Flo* units can be bolted directly to the floor. Large units need only a simple slab.

Maintenance is low. There is no wear and tear on compressors from shock and vibration ... no pistons and valves.

A Type and Size for Every Need

Single-stage units for pressures to 50 pounds gauge, and volumes from 42 to 3245 cfm. Two-stage units for 250 to 1800 cfm at pressures from 60 to 125 pounds gauge.

Single and two-stage vacuum pumps for vacuums to 0.3 inch mercury absolute from 22 to 5950 cfm.

GET INFORMATION — Call your nearest A-C office or write for bulletins 16B8244 (2-stage) and 16B8126 (1-stage). Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.

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ALLIS-CHALMERS

A-5134

PERSONALS (*Continued*)

PEGGY KEENAN, former concert pianist, now president of Northwest Defense Minerals, Inc., Spearfish, S. D., may be the first woman actually at the North Pole. Her husband, John F. Stanwell-Fletcher, primarily an explorer, is planning an arctic trip later this year. Miss Keenan began her mining career in 1948 when she heard of some promising claims for sale in the northern Black Hills. She hired an engineer whose report came back favorably, so she purchased the claims. Since that time she has obtained mineral rights on five other areas in the Black Hills, and in 195 she used her holdings for the nucleus of a new $1-million corporation—Northwest Defense Minerals, Inc. She's given up her piano career almost entirely now and has taken up full-time residence in Spearfish. Her switch to the mining business was far from a blind jump—her father was a miner. As she puts it—"I was always interested in mining, and even after I became a pianist I was quit a rock hound."

David O. Beeler, mining engineer, has been transferred to the Spokane, Wash., office of Anaconda Co. He formerly was with the company's Tucson, Ariz., office.

Robert G. Woods, industrial engineer at the Hayden smelter since 1951, has been named general foreman in the leach-precipitation-flotation plant, Ray Division of Kennecott Copper Corp. **Sidney H. Bruneau** of Kennecott's Utah division has been appointed shift foreman of the sponge iron and acid plant at Hayden.

A. J. Jacobs, formerly of Phoenix, Ariz., has joined the Kennecott Copper Corp., Chino Mines Division in Hurley, N. M., as a member of the labor relations staff.

Salisbury Adams, general counsel and secretary of Lithium Corp. of America, Inc., has joined the firm on a full time basis. He is a member of AIME.

J. B. Haffner, retired president of the Bunker Hill Co., has been elected a director of Federal Uranium Corp., Salt Lake City. Mr. Haffner, who was with Bunker Hill for 14 years as general manager and president from 1954 to 1956, has held supervisory posts with Tintic Standard Mining Co., Park City Consolidated Mining Co., and Consolidated Coppermines Co.

OBITUARIES

Anton Skubic, 48, of Skubic Brothers, mine operators in Virginia, Minn., died in Virginia on Feb. 15. Skubic Brothers have operated the Virginia mine at Eveleth since 1953.

Roy R. Smith, 61, Ironwood, Mich., mining captain at Pickands, Mather & Co.'s Cary mine, died recently. He had been at the Cary mine since 1928 and was promoted to mining captain in 1932.

Azro N. Lewis, 73, president of the Original 16 to 1 mine in California's Sierra County, died Feb. 17. He had been associated with the company for many years and was its vice president before taking over as president six years ago.

Mrs. Kate Rockwell Matson Van Duren, 76, known as Klondike Kate, the dance hall girl of Dawson City, Alaska, who gained fame during the time of the 1900 Gold Rush into the Yukon, died Feb. 21 at her home in Sweet Home, Ore.

Joseph F. Joy, 73, founder of the Joy Manufacturing Co., died Feb. 19 at his home in Ft. Pierce, Fla.

Henry W. Kaanta, 67, until his retirement a year ago superintendent of the American Smelting & Refining Co. mill which had been built under his supervision at Deming, N. M., died September 4 in El Paso, Tex., after a brief illness. Mr. Kaanta was graduated from the Colorado School of Mines in 1915 with an E.M. degree, and his work took him all over the world. He was with the General Engineering Co., Phelps Dodge Corp., American Smelting & Refining Co., San Francisco Mines of Mexico, Ltd., and in Russia for seven years as manager of the concentrating department of the Glavsvetmet Trust, Moscow. He was a member of the AIME.

Harold Lakes, 70, one of the foremost authorities on mining in the Kootenay area, and the discoverer of tungsten at the Emerald Mine in British Columbia, died Dec. 25, in Kootenay Lake General Hospital. Born in Golden, Colo., the son of a mining engineer, he first pursued mining in Idaho, Colorado, Mexico and New Mexico, before coming to British Columbia in 1914. In 1950, Mr. Lakes became general manager of the Emerald mine and was well in stride in this latest advancement of his career when he was taken ill in 1951. Since that time he had been acting as consultant engineer for Canadian Exploration. He was past president of the Chamber of Mines of Eastern B. C.

Letters (*Continued from p 103*)

ium producers.

In the article on "Rim Flying with the Uranium Institute" you state that the Pronto Uranium Mines, Ltd., quarterly statement shows that the company is receiving between $11 and $13 for its uranium. The Pronto price is substantially below the figures named, but since actual prices in Canada cannot be disclosed we are unable to give you the exact figure.

On page 174 your Saskatchewan correspondent mentions that the Eldorado Mining & Refining, Ltd., operation at Beaverlodge, Saskatchewan, is handling 150 tons per day from Rix Athabasca and 90 tons per day from Nesbitt LaBine on a customs basis. As a matter of policy our mill can treat a maximum of 150 tons per day of custom ores. The actual tonnages mentioned in the article should read "100 tons per day from Rix Athabasca and 50 tons per day from Nesbitt LaBine." I might add that the latter discontinued shipping ore to the Beaverlodge mill several months ago and that 50 tons per day of National Explorations ore is being treated in its place.

On the same page your correspondent mentions that Gunnar mill heads have reached $40 per ton or about 1% U_3O_8. We believe that the $40 per ton figure is reasonable but the grade certainly is not. If, as the article states, Gunnar's grade is double that of the Blind River mines we would expect it to be in the 0.20% range. Since ore grade statistics are no longer classified you can obtain actual grade figures from the Gunnar organization, providing they are willing to divulge such information.

We are drawing your attention to the above with the intention of emphasizing the necessity for accuracy in reporting statistics on Canadian uranium production. Such inaccuracies as those above may tend to mislead your readers with regard to the production and earning potential of Canadian uranium mines.

R. J. Henry
Vice President, Operations
Eldorado Mining & Refining, Ltd.
Ottawa, Canada

Correction

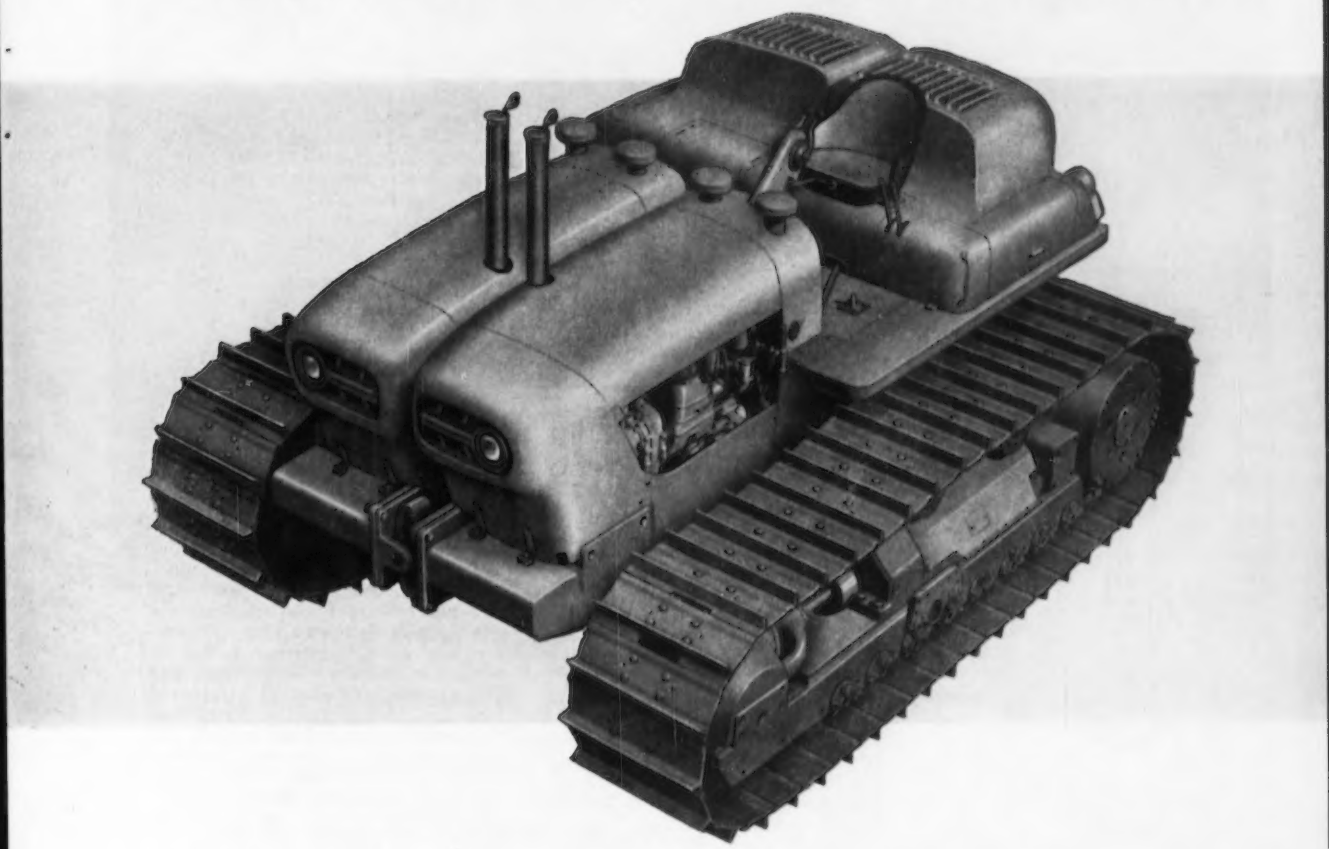
In the February issue of *E&MJ*, the Annual Survey and Outlook Issue, the table on p 105 headed "Cadmium Statistics" should have carried the subheading "Thousands of pounds."

In the second paragraph of the article on manganese, p 110, the words "carload lot" were omitted. Sentence should have read, "Duration of the carload lot program was changed from June 30, 1958" . . . etc.

In the section of the same article which discussed foreign ores, the imports of the five leading suppliers should have been given as "accounting for three-fourths of U. S. imports through September" or for the first nine months.

NOW THE Euclid TC-12 GIVES YOU

more horsepower... more track area... more accessibility than any other crawler!



Ever since it was introduced more than a year and a half ago, the Euclid TC-12 Tractor has set completely new standards of crawler production and performance. It has proved, on job after job, that it is years ahead of the field in ability to do more work—faster, easier and cheaper. Now the TC-12 has even more power to handle the biggest tractor jobs.

Powered by two 218 h.p. engines with separate Torqmatic Drives for each track, there's a total of 436 horsepower. Big 27″ standard shoes and 8 track rollers give good balance with the additional horsepower, heavy duty dozer blades and other attachments.

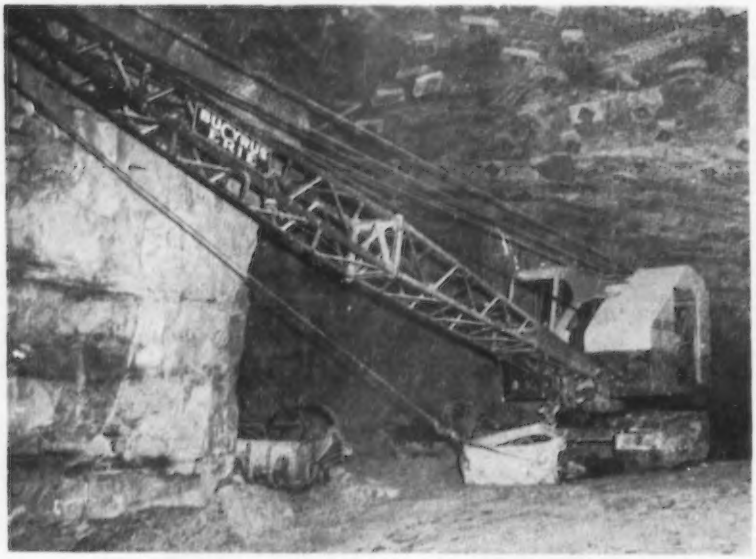
This new TC-12 Crawler has many other improvements that put it even further ahead of other tractors . . . in performance, ease of operation, maneuverability and service accessibility. Ask your Euclid dealer to prove that the TC-12 has no equal for big tractor jobs and have him show you why ***Euclids are your best investment.***

EUCLID DIVISION GENERAL MOTORS CORPORATION, Cleveland 17, Ohio

Euclid Equipment

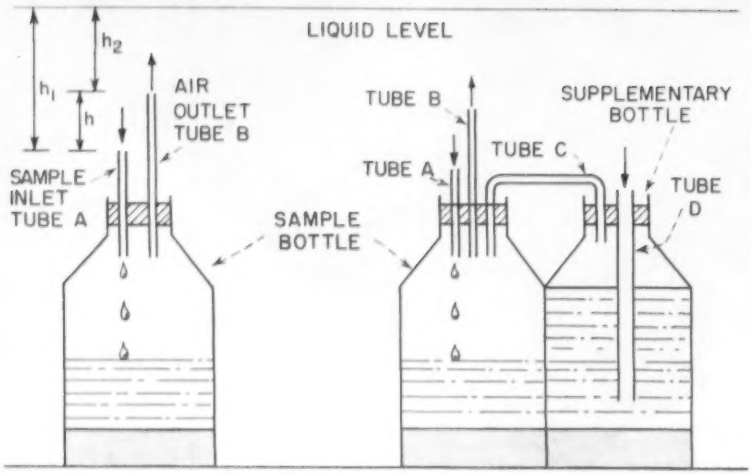
FOR MOVING EARTH, ROCK, COAL AND ORE

OPERATING IDEAS



Crane Aids Safety

DRAGLINE CRANE used underground eliminates hazard to men when recovering broken ore from pillars or when under any dangerous roof at Standard Uranium near La Sal, Utah. Sheave on end of 35-ft boom serves as mobile tail block for rigid hoe-type slusher bucket. Gathered muck is loaded into transporters with other equipment. Under certain conditions, regular ¾-yd dragline bucket can be used to load as well as gather. Note abundant use of rockbolts with timber blocks and pierced-plate landing mat as spreaders. Roof is easily fractured, fairly weak and fairly thin bedded limy sandstone. Room and pillar scheme of mining is used with "under-the-bed" haulage from raise chutes. Robert R. Durk, Standard's superintendent, furnished data.



Dry Ice Makes Welding Safe

TO WELD PUNCTURES in gas tank without it exploding, Paul C. Ziemke, Clinton, Tenn., reports a "fool-proof" method. About 8 lb of crushed dry ice was poured into fuel tank of Euclid truck after it was drained. Before welding with oxy-acetylene torch, repairman waited 15 minutes to insure all ice expanded into CO_2 gas which expelled all oxygen and condensed residual gasoline fumes. Latter drained to lowest point in tank. Immediately after being repaired, tank was refilled and placed back in service since small quantity of dry ice chips remaining in bottom of tank had no adverse effect on the gasoline.

Simple Sampler Operates Submerged

LIQUID OR SLURRY SAMPLER that collects drops from liquid in which submerged, has several advantages according to correspondents Takashi Goto and Tatsuo Hiraoka of Nippon Light Metal Co. Ltd., Shimizu, Japan. Successfully used in plant work, it is non-mechanical, simple to construct and low cost. Sampling is continuous at a constant rate, widely adjustable and suitable for any sample size within limits of available bottle sizes.

Single-bottle type (on left in sketch) serves for most purposes. But for more accurate sampling under certain conditions, two-bottle type is preferred. Materials required are merely bottles, stoppers, some capillary tubing and weight for submerging bottles.

When single-bottle is first submerged, pressure at top of inlet Tube A is head (h_1) plus atmosphere, and pressure at top of Tube B is head (h_2) plus atmosphere. Pressure in bottle increases due to inflow of liquid and/or to temperature. When pressure becomes h_2 plus atmosphere, air will begin to discharge through B. Thereafter constant pressure difference of h_1 minus h_2, or h, will exist between inlet and outlet. Bottle pressure remains constant and thus inflow or sampling rate remains constant.

Flow rate is determined by inlet tube size (diameter, d), submergence difference (h) and specific gravity of liquid (g). It is proportional to: $d^2(hg)^{1/2}$. Viscosity and other factors in fluid mechanics are neglected in practical plant use where there are no highly viscous liquids or very dense slurries.

With single bottle, flow rate will not remain constant during initial period while bottle pressure is increasing from atmospheric to atmospheric plus h_2. Use of a supplementary bottle as on right of sketch, will prevent this inconsistency by raising pressure in sample bottle more rapidly. Tube D can be larger or multiple tubes can be used for faster inflow. By having top of D lower than A, submergence difference between B and D is increased and flow rate is raised.

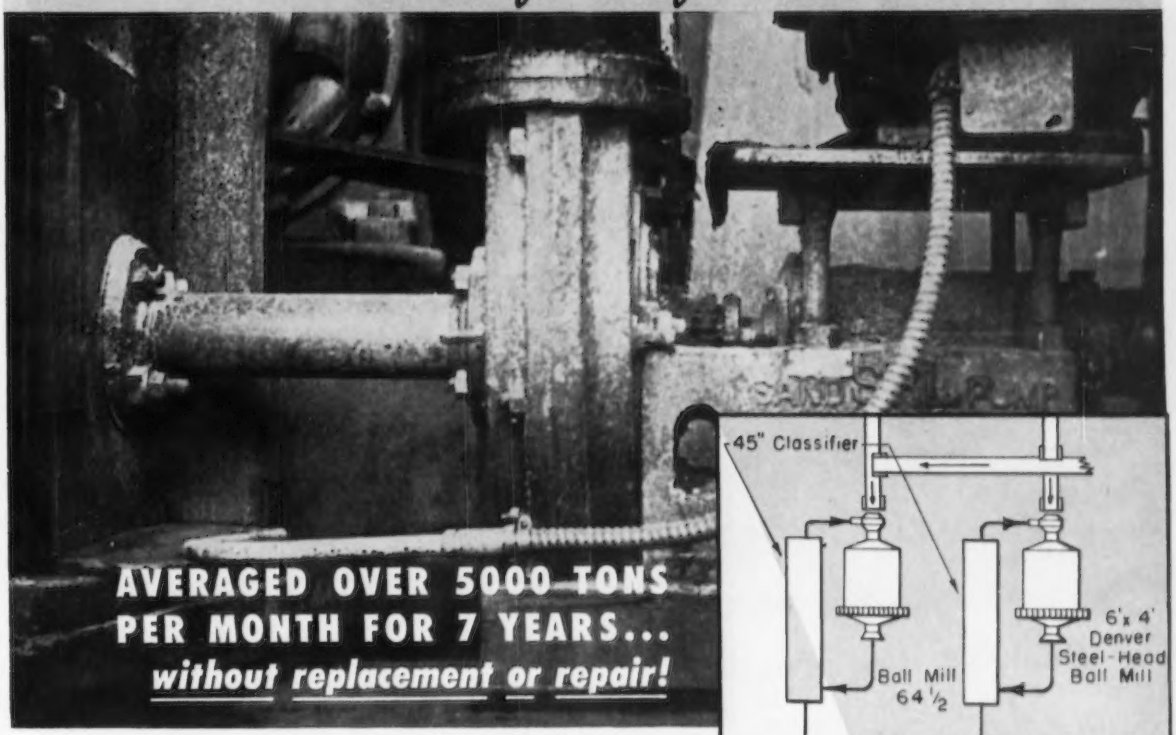
According to authors, size of supplementary bottle needed can be calculated from the relationship:

$$V_e = V_s\left[\frac{(10 + H\rho)(273 + t)}{10(273 + t')} - 1\right]$$

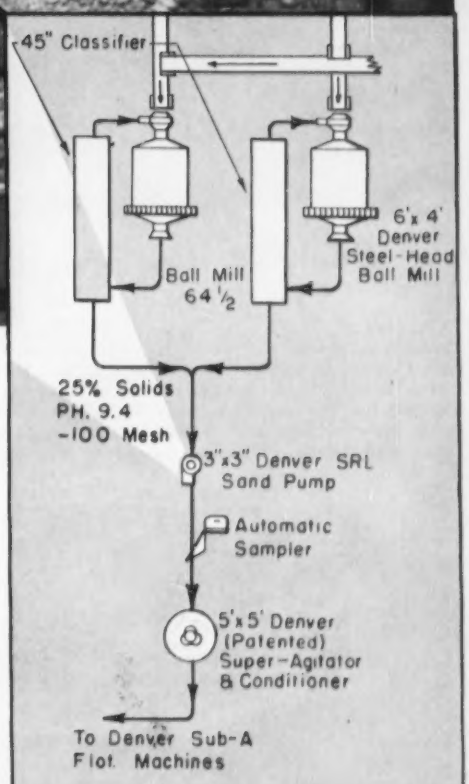
where V_e and V_s are respectively the supplementary and sample bottle volumes, H is submergence of Tube A in meters, and t and t' are respectively the temperatures of the air in the bottles before submergence and of the solution in degrees Centigrade. If V_e comes out negative, no supplementary bottle is required.

DENVER SRL PUMP

on classifier overflow . . .



AVERAGED OVER 5000 TONS PER MONTH FOR 7 YEARS...
without replacement or repair!


45" Classifier
6'x 4' Denver Steel-Head Ball Mill
Ball Mill 64½
25% Solids PH. 9.4 -100 Mesh
3"x3" Denver SRL Sand Pump
Automatic Sampler
5'x5' Denver (Patented) Super-Agitator & Conditioner
To Denver Sub-A Flot. Machines

Case history of this installation is available in DECO Engineering Notebook Bulletin M4-B46.

This firm ordered its first DENVER SRL (Soft Rubber Lined) SAND PUMP in 1942 . . . and since has ordered six more. This particular pump (shown above) averaged over 5000 tons per month for 7 years . . . without replacement of parts and without repairs of any kind!

Why not have your firm avail itself of performance like this by installing DENVER SRL SAND PUMPS in your mill? These pumps and parts are in Colorado Springs for quick shipment!

Clyde V. Johnson, graduate metallurgical engineer with many years' experience, can help you solve your pumping problems . . . and reduce pumping costs! He suggests that you select a pumping problem in your mill and get our SRL Pump recommendations. Why not have a pump with reliable reputation?

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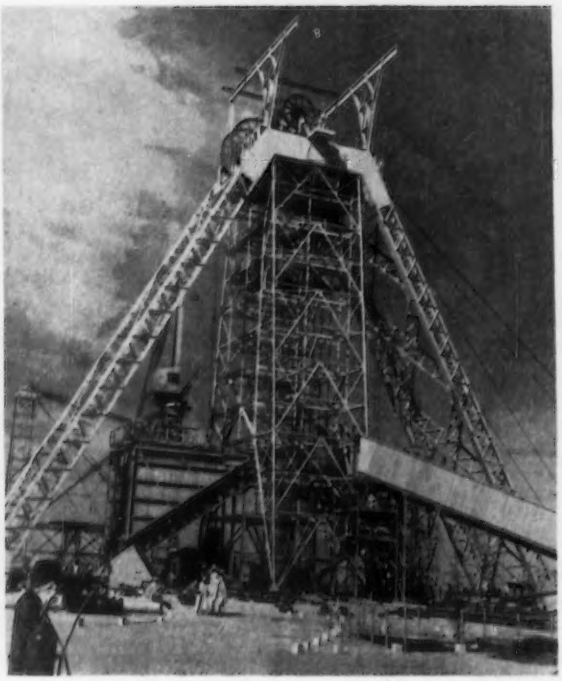
OPERATING IDEAS *(Continued)*

Dumping Door Is Better

U-SHAPED STEEL ARMS, rigidly attached to dumping door, suspend counterweights for keeping door clear of shaft during shaft sinking at National Potash Co., Carlsbad, N. M. Weights hang freely outside headframe. No sheaves or cables are needed. For dumping, air cylinder swings door down and muck runs through chute directly into trucks. Design insures that door will remain clear even if power fails.



Headframe Is Doublesided

CIRCULAR SHAFTS with double row of compartments require special headframe designs such as this one at No. 1 shaft Harmony Gold Mining Co. Ltd., Glen Harmony, Orange Free State. Now in the process of being sunk, shaft has winders (hoists) on opposite sides. Sheaves are in two parallel lines on platform. Platform is supported by large inverted V-like steel frame structure which resists all winding loads. It is strong but simple in construction and appearance. Lighter center structure is connected flexibly to other frame, its sole function being to support skip-dumping and related facilities.

At previously built No. 1 shaft, winders are placed on two adjacent sides, at 90 deg to each other with sheaves likewise at 90 deg. Sheaves were at same level. Design is successful.

In recent years, opening of new gold mines—often very deep—in the Orange Free State and western Transvaal, Union of South Africa, has led to considerable advances in shaft designs and layout which have been reflected in new headframe designs. Circular shafts are now in general use with compartments in two rows instead of the single row commonly used in rectangular shafts. For drum hoists this necessitates placing sheaves and hoists close together if winding is to be from one side of the shaft as in the past. Sheaves at different levels and deflection wheels to prevent ropes fouling each other, complicate matters. Several installations have been friction drives mounted in the familiar, tall concrete headframes.

Waste Heat Warms Headtower

SURPLUS HEAT from electrical machinery is sole thermal source for heating Lousavaara-Kiirunavaara's new shaft and ore-dressing plant at Kiruna, Sweden. Winter temperatures frequently range from 20 to 40 degrees below zero. Outside of monolithic concrete headtower is covered by 4-in. layer of plastic-treated glass wool and finally 1/24-in. gage corrugated aluminum. Building mounts eight friction hoists and was cast in two lifts by means of a 720-ft long sliding form. Plant is claimed ten years ahead of general mining technology.

Start sending us your Operating Ideas. There's a reward for those we can use.

Longyear

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Longyear Hi-Speed Air Leg Diamond Core Drill

Powerful . . . Portable . . . One Man Operated

Now, Longyear applies the advantages of Air Leg design to underground coring. The new Hi-Speed Air Leg is a drill that one man can carry, set up easily and operate efficiently. Powerful and rugged, it requires *no spraging or bracing* . . . uses standard E or XRT tools . . . is driven by a 10 hp air motor and mounted on a powerful four-inch Air Leg that provides ample bit pressure.

The drill operates either in line with the Air Leg or at an angle to it, and drills up to sixty feet. Field reports emphasize that this powerful, compact core drill can be used in confined spaces. Write for information and specifications on this important addition to Longyear's world acclaimed line of Diamond Core Drills.

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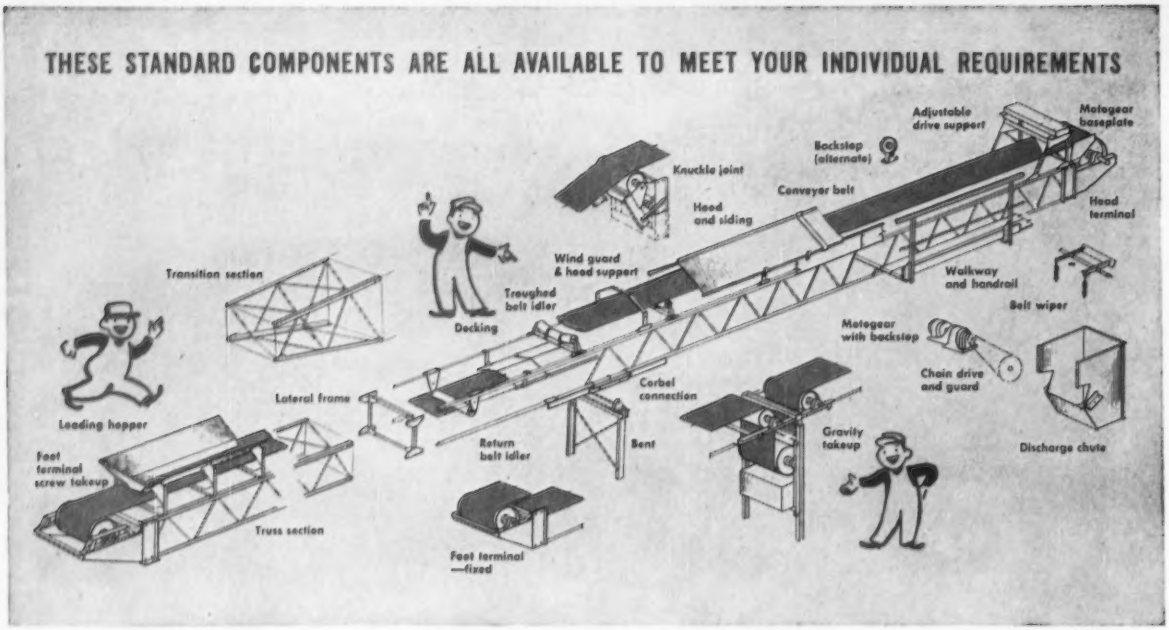
THE WORLD IS OUR WORKSHOP



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Book 2579 has further data on Link-Belt PRE-BILT conveyors . . . with drives up to 40 hp and 24 and 42-inch truss depths. Write today, or ask for a copy at your nearest Link-Belt office.

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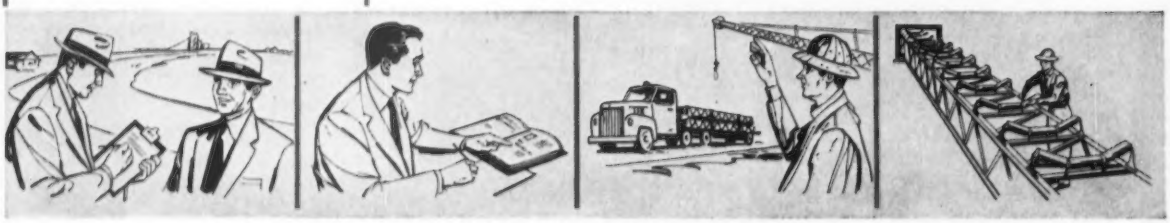

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A Progress Report on Faculty Salaries:

UP . . . But Not Nearly Enough

THE CHART on this page provides a report of the progress being made in solving a problem of crucial importance to every American. The problem is that of seeing that college and university faculty members get decent salaries.

This new chapter, which brings the story forward two years—from 1954, when it was last dealt with in this series of editorials, through 1956—has a decidedly cheering element. For in the last two years faculty salaries have made real headway.

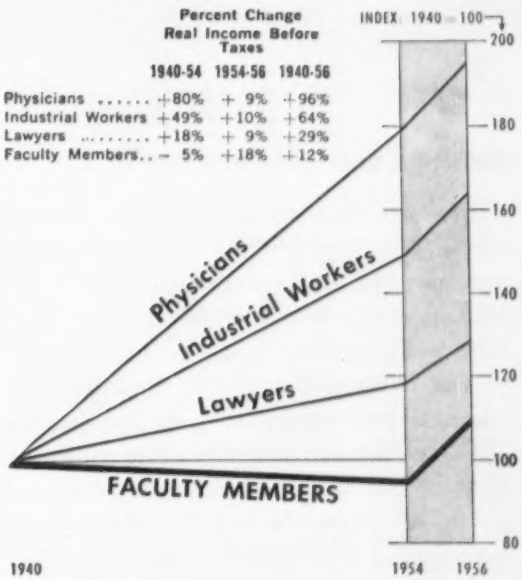
Two Years of Improvement

In 1954, in terms of what their salaries would buy, faculty members as a whole were actually worse off, by 5%, than they had been fourteen years earlier. As the chart shows, over the same period the real income of the average industrial worker had increased by almost half. And, in what it would buy, the income of the average physician, with professional training comparable to that of the average faculty member, had jumped by 80%.

In 1956, however, the average faculty salary would buy about 12% more of goods and services than it would in 1940. Relative to where they were two years before, faculty salaries showed a larger gain over the two years than those of any of the other groups whose salary progress is charted.

This movement of faculty salaries in the right direction has many contributing causes. The biggest single boost was given by the great Ford Foundation gift of half a billion dollars to our colleges, universities, and hospitals, almost half of which was ear-marked for faculty salary increases. Gifts from business firms have also

What is Happening to College Faculty Salaries



DATA: Council for Financial Aid to Education, U. S. Dept. of Commerce, U. S. Dept. of Labor, National Association of Education Research Dept., McGraw-Hill Dept. of Economics.

helped a lot. And so, in many cases, have stepped-up money-raising campaigns by alumni groups and cooperative regional and state groups of colleges.

Still a Long Way to Go

However, faculty salaries started their ascent from such a dismal depth that they still have a long, long way to go up before there is room for the comfortable conviction that they are fair, or even safe, from the standpoint of protecting the nation's vital interests. It still remains possible to find many shocking companion pieces for the following incident recently reported to a McGraw-Hill executive group, working on problems of financial aid to higher education, by the president of an illustrious small liberal arts college.

"The recruiting officer of one of our large industrial companies came to our campus a few weeks ago," the college president said, "and offered five of our seniors higher salaries to start working for that company when they are graduated next June than the salary received by any member of our faculty. And the seniors, of course, promptly went to their professors to seek advice on whether or not they should accept. It doesn't take much imagination to see what this sort of thing does to the morale of a faculty."

Senior Teachers Fare Badly

One of the more devastating things it does, of course, is to make the more experienced college and university faculty members receptive to the idea of going to greener pastures, currency-wise, in business and industry.

For these senior faculty members the financial pounding in the past 16 years has been even worse than the chart indicates. While the average real salary gain reported by the chart has been 12%, the average salary of a full professor still buys less than it did in 1940. This is because most of the salary increases have gone to beginning instructors, for whose services industry has been providing the sort of competition reported by the liberal arts college president.

And it creates this financial lackluster of posts as senior college faculty members right at the time their services are needed more than ever to handle the oncoming flood of college and university students. Between now and 1970 college and university enrollment is expected to double.

What is Needed Now

What is clearly needed is a continuation and intensification of the drive to increase their salaries to a point where college and university faculty members will be sharing somewhere near fully in the general prosperity of the nation. It could be counted good progress in this direction if over the next two years faculty salaries on the average were to go up another 12%, with most of the increase concentrated in the senior faculty ranks. And this can be made possible only through more outside contributions.

There is reason to be encouraged by the progress that has been made over the past two years in bailing college and university faculty members out of the terrible financial hole into which they were allowed to slide. But there is the most urgent occasion to keep at it and harder.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C McGraw

PRESIDENT

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Production Was Slow

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Today's grinding is as fast as yesterday's was slow. The modern mill produces many tons of ore in a single day, thus making possible our "metal age" civilization. This amazing production is possible largely because modern mills utilize efficient grinding media like the grinding balls and grinding rods produced by CF&I. Since they are always produced from special analysis steels that have the proper balance between toughness and hardness, CF&I Grinding Balls and Grinding Rods assure optimum grinding ability and maximum wearing ability.

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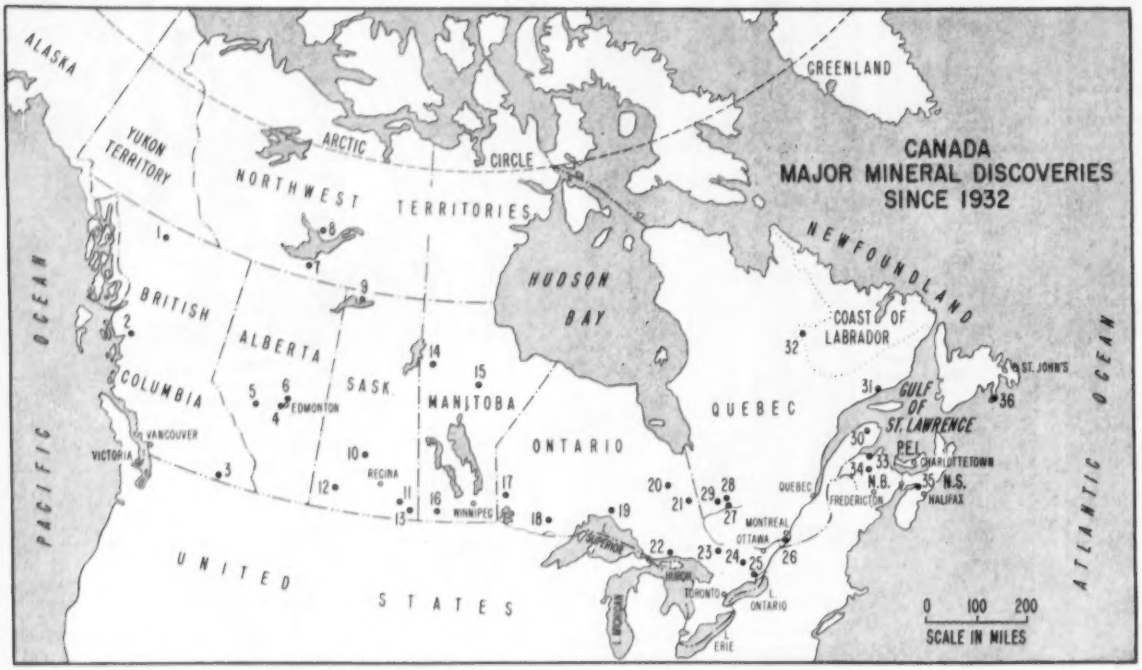
THIS MONTH IN MINING *(Continued from p 73)*



Prospectors and Developers Chart Highlights of 25 Years

British Columbia
1. Cassiar Asbestos 1950
2. Granduc Mines 1951
3. Emerald 1942

Alberta
4. Leduc 1957
5. Pembina 1953
6. Redwater 1948

Northwest Territories
7. Pine Point 1929-1950
8. Yellowknife 1935

Saskatchewan
9. Beaverlodge 1945
10. Patience Lake 1953
11. Midale 1952
12. Cantuar 1952
13. Frobisher 1954

Manitoba
14. Lynn Lake 1941
15. Mystery Lake—Moak Lake 1946
16. Daly 1951

Ontario
17. Gordon Lake 1942
18. Steep Rock 1938
19. Manitouwadge 1953
20. Mattagami
21. Matheson 1948
22. Blind River 1953
23. North Bay 1952
24. Bancroft 1952
25. Marmora 1949

Quebec
26. Oka 1953
27. East Sullivan 1943
28. Barvue 1950
29. Quebec Lithium 1942
30. Gaspe 1938
31. Allard Lake 1941

Labrador
32. Knob Lake 1929-1942

New Brunswick
33. Bathurst 1952
34. Little River 1954

Nova Scotia
35. Walton 1940

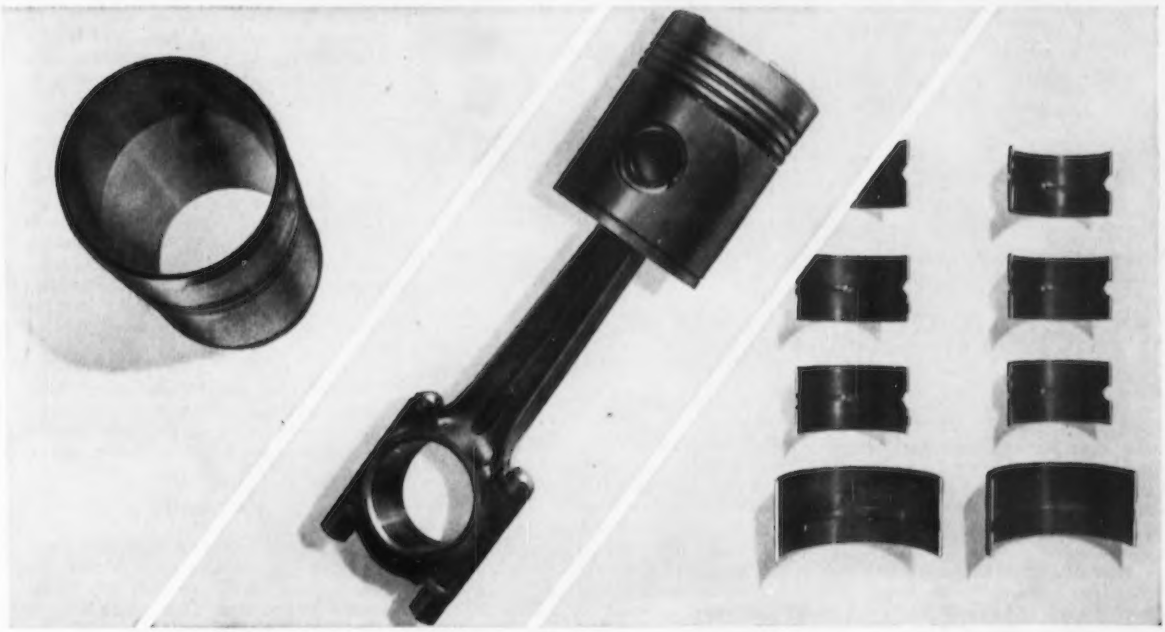
Newfoundland
36. Fluorspar 1932

NEIGHBORLY GREETINGS were extended to Viola MacMillan by Robert S. Palmer, executive secretary, Colorado Mining Assn., who presented a silver tray. Mrs. MacMillan was elected to her 14th consecutive term as president.

The Engineer's Field Report

CASE HISTORY
LUBRICANT RPM Delo Oils
FIRM Progressive Transportation Co, Compton, California

RPM DELO holds piston wear to .001" after 201,253 miles of on-and-off highway hauling



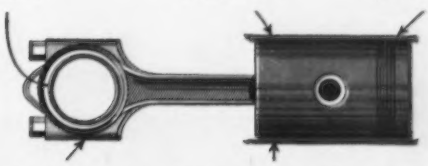
LUBRICATED WITH RPM DELO Oil, these engine parts were pulled from a Cummins HR diesel after 201,253 miles. A portion of this mileage was put on during four months of rugged service spotting loads of heavy pipe in the Arizona desert. When the engine was taken down, after two years of this on- and off-highway hauling, Progressive Transportation Co. found RPM DELO Oil had kept lacquer, gum, sludge, and deposits from forming...rod bearing wear varied between .0005 and .001 inch and pistons showed maximum wear of only .001". No wear at all evident on main bearings. Progressive Transportation uses RPM DELO Oils in all its large fleet of tractors—some of which have traveled well over 200,000 miles without overhaul.

Why RPM DELO Oils prolong engine life

Special compounds stop corrosion

Anti-oxidant resists lacquer formation

Detergent keeps all parts clean



Metal-adhesion qualities keep oil on parts in running or idle engines—inhibitor resists foaming

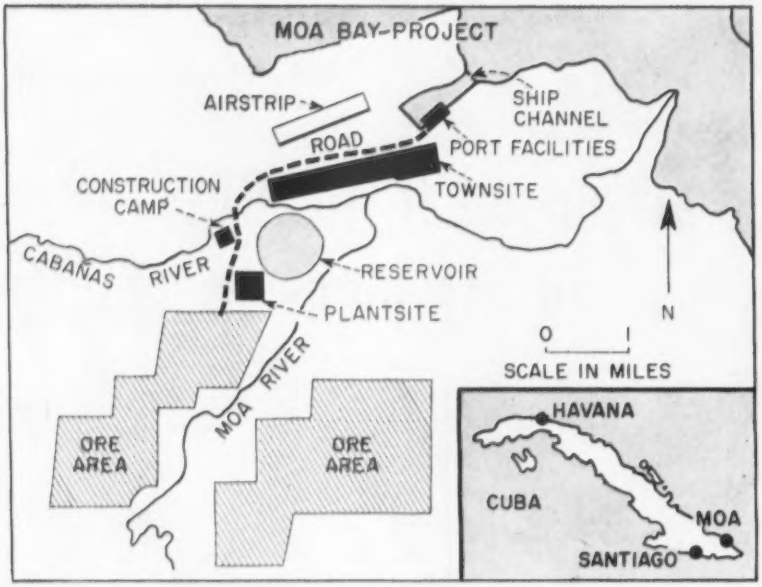
LUBRICATING OILS RPM DELO

For More Information... about this or other petroleum products of any kind, or the name of your nearest distributor, write or call any of the companies below.

STANDARD OIL COMPANY OF CALIFORNIA, 225 Bush Street • San Francisco 20, California

THE CALIFORNIA COMPANY, P. O. Box 780 • Denver 1, Colorado

STANDARD OIL COMPANY OF TEXAS P. O. Box 862 • El Paso, Texas



ORE AREAS at Moa Bay will supply nickel and cobalt for the new facility.

Freeport Signs for Ni-Co Sale

A CONTRACT to buy up to 271-million lb nickel and 23,835 lb cobalt between now and June 30, 1965 has been signed by the U. S. Government and Cuban American Nickel Co., subsidiary of Freeport Sulphur Co. Government has the right to require delivery of 30% of the new plant's output.

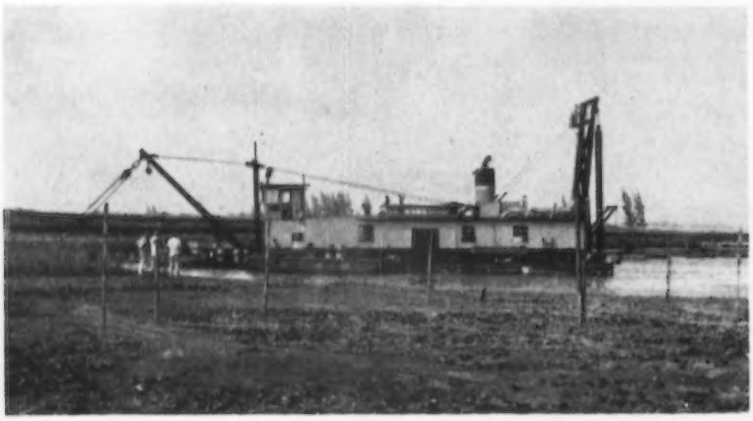
New property involves construction at Moa Bay, Cuba, where Freeport will mine the ore and beneficiate by sulphuric acid leaching, and in Louisiana, where nickel and cobalt will be separated. The facilities, according to Lanbourne M. Williams, Freeport president, will utilize a new process which provides high-purity nickel as a metal rather than an oxide. Cobalt will also be recovered in metallic form.

Annual production from the project, Williams said, will be about 50-million lb nickel and 4.4-million lb cobalt. Cost of more than $100-million also involves new construction at Moa Bay plant site, townsite and dredging of a ship channel to the loading dock (see map).

Purchase of production from the new company is based on current price of nickel at Port Colborne, Ont., as follows: When the company initiates sales to the Government, the price will be 74c (the current price); when the Government takes the initiative in buying, price will be the Port Colborne price at time of sale or 74c, whichever is the higher.

At Moa Bay, Freeport and its subsidiaries have in excess of 50-million tons of limonite averaging 1.35% Ni, 0.14% Co and 46.5% Fe. The orebodies are on the northeastern coast of Cuba in a serpentine formation. They are mined by open pit.

Contract is the first under ODM's new policy of helping new nickel processing techniques and facilities to handle lower grade ores which were previously considered unusable.



SHIP CHANNEL was cleared to handle ships picking up Ni-Co concentrates.

Bureau of Mines Offers Technical Careers

ALLAN SHERMAN, chief of the office of mineral reports, U. S. Bureau of Mines, has announced a recruitment program for persons interested in career jobs in technical and administrative fields.

"The expansion of research and development programs of the U. S. Bureau of Mines, as proposed in its budget for the coming year, creates additional opportunities for engineers and scientists interested in Government career positions. The Bureau is now seeking metallurgists, ore dressers, engineers (mining, petroleum, mechanical and electrical), chemists, physicists, nuclear physicists and qualified specialists in other technologies."

Vacancies range from $4,480 to $7,570 per year and include some "high level administrative and supervisory jobs." Applications may be directed to the Bureau headquarters or to district offices.

Sweden Expands

ACCORDING to recently published long-range economic program, drafted by five experts, output of iron ore is expected to rise from 17.5-million tons in 1955 to 21.4-million tons in 1960. As domestic consumption is likely to increase from 2.1-million to 3-million tons, quantity of iron ore available for export would rise by three million to 18.4-million tons. Steel production is estimated to advance from 1.5-mililon to 2.2-million tons.

Nicaro Expansion Plan Completed in March

A 75% EXPANSION PROGRAM at the Government-owned nickel plant at Nicaro, Cuba, was completed on schedule last month, and at a cost of $6-million under the original estimate. Program brings rated capacity of the project to 50-million lb nickel per year.

National Lead Co., whose subsidiary operates the plant, was the prime contractor on the job, which will cost $37-million when all bills are in. Original estimate was $43-million. Plant set a production record in 1956, despite construction under way. Output was 32-million lb last year, compared with 30-million lb in 1955.

Boulder Crusher AR-180

Six of these huge crushers are being supplied for use underground in Swedish iron mines at Kiruna and Malmberget.

The AR-180 with its 71" x 55" feed opening is the largest single-toggle type Jaw Crusher in the world. It can accept blocks of iron ore up to 10 tons and reduce these to 16" thickness. It can be dismantled into component parts suitable for transportation and erection underground.

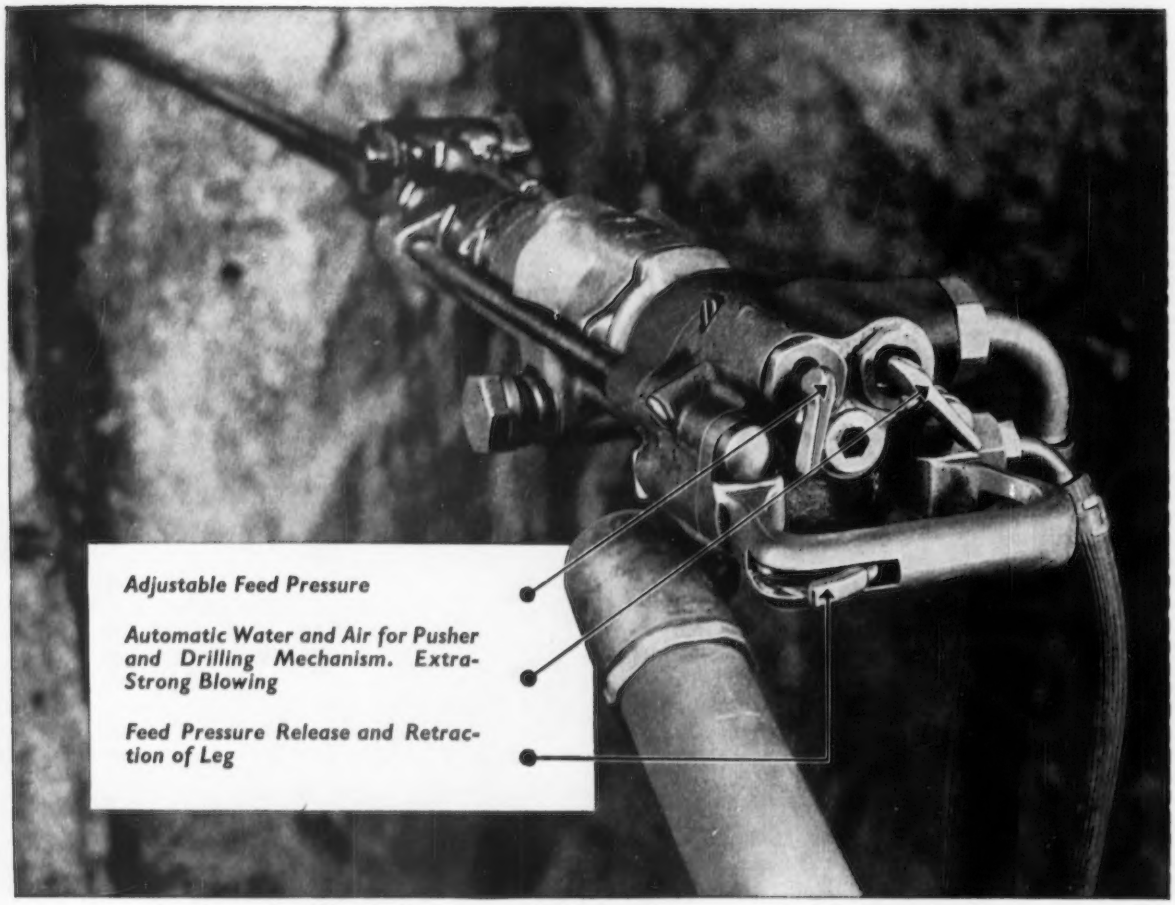
Built in three sizes

TYPE	FEED OPENING	SETTING	MIN. MINE SHAFT DIMENSIONS	NETT WEIGHT
AR–120	47" × 35"	12"	36" × 73"	81500 lbs
AR–150	59" × 47"	12"	57" × 89"	170000 lbs
AR–180	71" × 55"	16"	60" × 98"	256000 lbs

Single-toggle design — simple and strong.
Frame in sections, with interlocked bolted joints.
Side frames for the AR-180 and AR-150 are of heavy steel plate.
SKF spherical roller bearings — grease lubricated throughout — avoiding oil leakage. Low idling power consumption.

MH MORGÅRDSHAMMAR

MORGÅRDSHAMMARS MEK VERKSTADS AB • MORGÅRDSHAMMAR • SWEDEN


Adjustable Feed Pressure
Automatic Water and Air for Pusher and Drilling Mechanism. Extra-Strong Blowing
Feed Pressure Release and Retraction of Leg

RETRACTABLE LEG AND ONE-HAND GRIP-CONTROLS SPEED DRILLING TIME

For years Atlas Copco have been the world's largest manufacturers of pusher leg drills. Since 1937 when Atlas Copco, far ahead of any other manufacturer, introduced their first pusher leg drills, they have continuously improved the design of these drills. Their latest development, the Atlas Copco 'Lion', combines an unequalled ease of operation together with a high drilling rate—both contributing to a higher footage per manshift.

All controls under one hand

The Atlas Copco Lion is the first drill to have all the valves which operate the drill under the control of one hand. *Full control without having to move the hand from the backhead!*

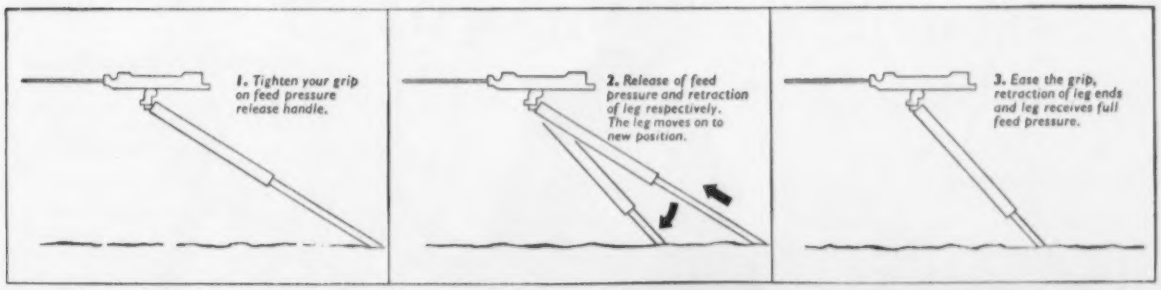
The valves are all easy to operate. By the use of only the fingertips the drill can be started or shut off, the feed can be adjusted to the pressure required, or retracted for an advance, and the extra air-blowing can be brought on to clean the holes.

All the control handles have been designed in such a way that they are well protected. While using them the operator's hand is never near the wall or roof of the drift. The Lion is the first pusher leg drill with controls placed for drifting.

Retractable leg saves time

When the leg has to be moved the feed pressure is easily released by squeezing the hand grip. By further pressure on the grip the leg retracts automatically.

Pusher leg moves forward with drill in full action


1. Tighten your grip on feed pressure release handle.
2. Release of feed pressure and retraction of leg respectively. The leg moves on to new position.
3. Ease the grip, retraction of leg ends and leg receives full feed pressure.

When the leg is in the new position suitable for continuous drilling, retraction stops and the feed pressure comes back by loosening the grip of the hand. *All this can be done while the drill is still running.*

This new idea of a retractable leg enables quicker repositioning of the leg and reduces the number of steel changes, thereby increasing footage per manshift. When drilling high holes it is now far easier to alter the position of the leg more frequently in order to maintain an optimal feed angle and feed pressure.

Packed with power for deep holes

The Lion has a drilling rate at least 30% higher than other rock drills of the same weight. Furthermore, it is designed so that it can maintain its high speed *even when drilling deep holes.* This means quickly drilled deep hole rounds and a faster, steadier advance. You'll also find that the Lion reduces *to a minimum* the gauge wear of the bits in abrasive rock. And owing to the ease with which the feed pressure is released and brought back into action, the Lion is a *handier* drill to work with in fissured rock.

Sandvik Coromant—the right steel for the Lion

All Atlas Copco drills—and this goes for the Lion—have been developed from the earliest stages with Sandvik Coromant tungsten-carbide-tipped integral steels and detachable bits. No drill or steel developed separately could ever give such equivalently high performances as this drilling combination. It is today the most widely used in the world, responsible for drilling more than one billion feet per year.

Free Demonstration! *Wire, 'phone or write* today *to any one of these offices and see the Atlas Copco Lion in action for yourself.*

U.S., Atlas Copco Pacific, Inc., 930 Brittan Avenue, San Carlos, California. Atlas Copco Eastern, Inc, P.O. Box 2568, Paterson 25, N.J.

CANADA, Atlas Copco Canada Ltd., Montreal Airport, P.Q.

MEXICO, Atlas Copco Mexicana S.A., Apartado 56, Torreon, Coahuila.

The ATLAS COPCO GROUP puts compressed air to work for the world. It is the largest group of companies specializing solely in the development and manufacture of compressed air equipment. It embraces Atlas Copco companies or agents manufacturing or selling and servicing Atlas Copco equipment in ninety countries throughout the world.

Without changing the grip of the hand the driller can easily position and control the machine, saving time and reducing fatigue.

Atlas Copco

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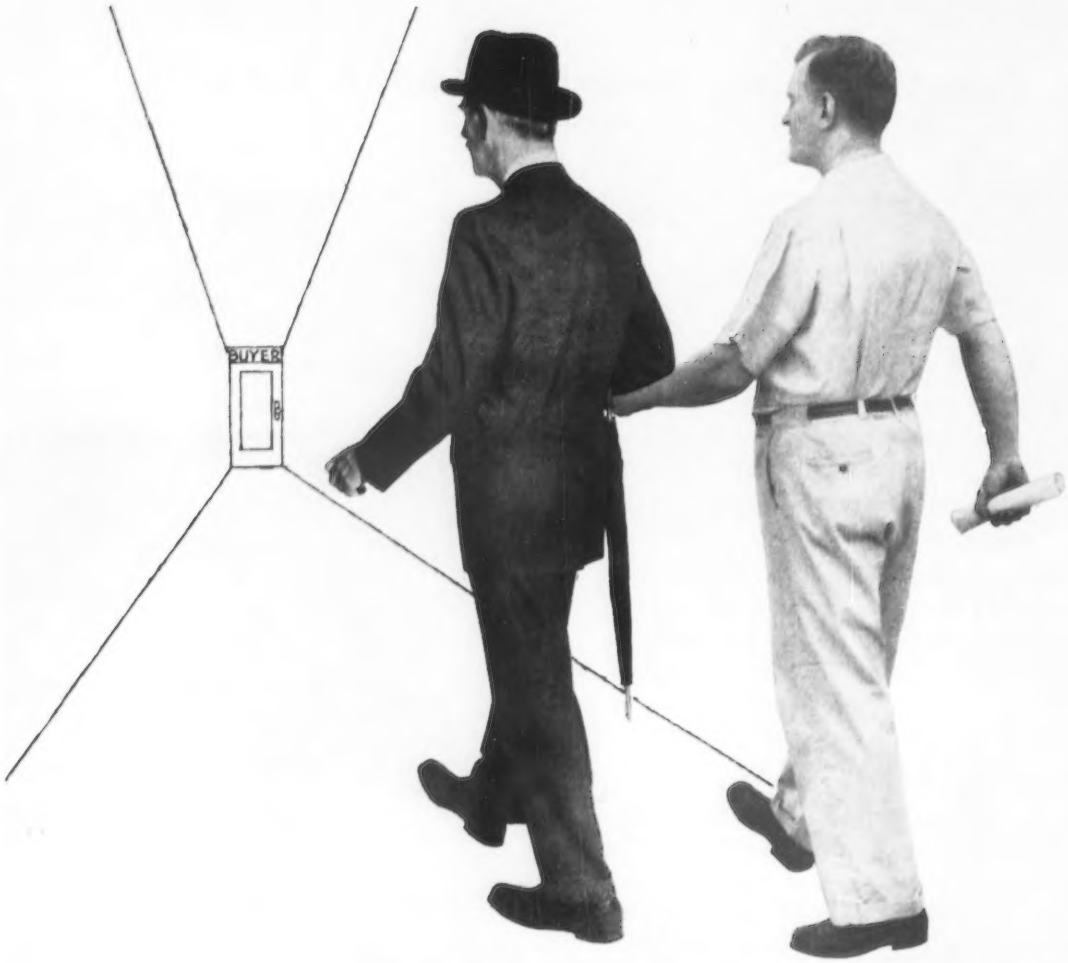
Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment



Your Wickwire Rope Distributor and our closer operator ...ready to help you

This closer operator—running a machine which forms our rope—is with your Wickwire Rope Distributor every time he makes a call.

True, he's physically in the mill, where he's carefully conducting this final fabricating operation. But, whenever your Wickwire Distributor makes a call, he has the full assurance that every foot of Wickwire Rope has been carefully assembled by skilled craftsmen . . . and that it will give you long, trouble-free service on your job.

It's just one more reason why your Wickwire Distributor knows he's got top-quality wire rope, slings and strand to sell . . . and that these products will serve you well.

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IN THE U. S.

ALASKA

Machinery Center, Inc., headed by mining engineer Roger Pierce of Salt Lake City, Utah, has been given contract to dispose of all equipment of the famous Juneau mine of the Alaska-Juneau Gold Mining Co.

William Norins, assistant to the president of Alaska-Juneau, Los Angeles, said the equipment was being sold off to reduce maintenance costs of the firm now engaged in diversification into manufacturing and other types of mining.

Norins stressed that mineral prospecting on about 15,000 acres of claims in the Juneau area would continue. No buildings are being sold.

ARIZONA

Pima Mining Co. has won the second round in its fight with a prospector who wants to work a lode claim at the bottom of the company's $10-million copper pit southeast of Tucson.

James Woolsey earlier had obtained a restraining order against the mining company while he did location work on a lode which he filed, claiming the company had filed placer claims enabling it to undertake surface work only.

Later Superior Court Judge Robert S. Tullar lifted the order, after Woolsey had been given time to do location work.

The judge indicated that "Woolsey should not be considered a claim jumper because there is a clear-cut case of confusion in the state land department."

Woolsey's attorneys have indicated they may ask the department to cancel Pima's claims.

Famed Eagle-Picher lead and zinc mine and mill south of Tucson has been sold to the McFarland and Hullinger Co. of Tooele, Utah. Sale price was not revealed for the historic property that dates back to 1870. The San Xavier mine is located 20 miles south of Tucson at Twin Buttes. The mill is 10 miles away at Sahuarita.

F. G. McFarland and S. R. Hullinger have been leasing the mine for the past two years and have 32 men at the mine and seven at the mill. W. D. Nelson will direct operations of the mine. J. L. Erickson, coming from Henderson, Nev., will be mill superintendent.

Eagle-Picher bought the mine from New Jersey Zinc Co. in 1943.

In August 1952, when the mine was shut down, it employed 350 men. It remained inactive until 1954.

Thanks to modern technological improvements, Arizona is going to remain a copper production leader for years to come —says the man most responsible for expansion of the industry in the state.

Louis Shattuck Cates, chairman of the board of Phelps Dodge Corp., told an Arizona meeting "exhaustion of mines is not in sight.

Are you getting the results you should from your fluid mixing operations?

Maybe you're wondering if a switch in your fluid mixing methods can give you process results that you're not quite getting now.

You're interested in boosting extraction values to a new level. You want to produce more uniform feed for a high-pressure chemical reduction. Or you'd like to tighten your control of crystal size.

And you suspect that the right *kind* of mixing could cut your operating costs substantially.

There's a good chance we can help you.

Predicting mixing results

Not long ago, some of our engineers showed a customer how to get highly uniform feed for his flotation cells—using only *half* the power input he'd been using.

Another customer asked us to figure out whether a *batch* or *continuous* mixed system would give him better extraction economies. We were able to predict his return from either system, giving him an accurate basis for making his choice.

What good mixing can do

We're convinced that mixing is a critical area in ore processing—and we'd like to convince you, to your profit.

We'd like to show you how good mixing can give you results you can measure—in terms of faster through-put, better extraction percentages, closer quality control, more product from fewer reactors.

We specialize in just one thing—*fluid mixing that does what you want it to do.*

No risk—here's why

We back it up, too. When you specify a LIGHTNIN Mixer, you're protected by an unconditional guarantee that the mixer will do the job for which it is recommended, or your money back.

You can get LIGHTNIN Mixers for any fluid mixing job, in tanks of any size and shape. The exact flow pattern that will give you optimum results is determined *scientifically,* with accurate prediction of results.

Your mixer is selected from hundreds of standard power-speed combinations, using data unique in industry and based on 30 years of research and field experience in fluid mixing.

You're served by a competent LIGHTNIN Mixer representative conveniently near you—and by prompt shipment of parts when you need them.

What to do now

If you'd like to know how modern fluid mixing can help give you the results *you're* looking for, just call in your LIGHTNIN representative. (He's listed in Thomas' Register.) Or write us for these helpful catalogs describing LIGHTNIN Mixers:

- ☐ Turbine, paddle, propeller types: top or bottom entering: 1 to 500 HP (B-102)
- ☐ Propeller types; top entering: ¼ to 3 HP (B-103)
- ☐ Portable: ⅛ to 3 HP (B-108)
- ☐ Data sheet for figuring mixer requirements (B-107)
- ☐ Laboratory and small-batch production types (B-112)
- ☐ Condensed catalog showing all types (B-109)
- ☐ Rotary mechanical seals for pressure and vacuum mixing (B-111)
- ☐ Side entering: 1 to 25 HP (B-104)

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Here is the Proved Way to Concentrate Minerals Efficiently

For more than four decades, the SuperDuty® DIAGONAL-DECK® Concentrating Table has been producing high grade concentrates at lower cost than is possible by any other comparable method.

The reason for this is found in a correct coordination of all tabling factors. Even the shape of the deck conforms to the natural path of material flow, eliminating non-producing dead areas and utilizing riffle functions to the utmost. The result is higher grade concentrates, minimum loss to the tailings and a greatly reduced middling load for recirculation, making room for more tons of new feed per day and cutting maintenance costs.

These results are proved. Send for complete data and Bulletin 118-B.

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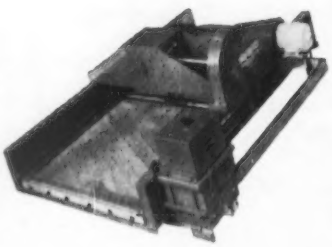
All New Model Leahy® screens utilize proven differential vibration that snaps oversize wedging particles loose 1600 times per minute. When dust is a problem, totally enclosed models are available. For damp screening, Flex-Elex® electric heating of the screen jacket insures full-time open mesh. For wet screening CONCENCO® spray nozzle arrangements are available.



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Arizona *(Continued)*

"We in Arizona are in the fantastic position of working on the lowest grade of ore in any copper operation yet, paying the highest wages, and still making a profit," he said.

Because of advanced recovery technique, R. G. Page, president of PD, noted that "When we opened the Morenci pit in 1937 we had 250-million tons of usable ore estimated. So far we have removed 218-million tons and we have reserves left that are larger than our starting estimates."

Shafts of the idled Silver Plate mine at Clemenceau, in north central Arizona, are being probed by a new company organized by Don Becchetti of Clarkdale to see if modern methods can make copper operations profitable.

The mine has not operated for 25 years. New exploration has turned up copper and rare earths in commercial quantities, Becchetti says.

In 1915 large copper producers carried on successful operations in the Verde district of Yavapai County, driving some tunnels, but quitting when they failed to find anything like the fabulous copper mines at Jerome.

ARKANSAS

Plans to install calcining facilities at Bauxite have been announced by G. W. Russell, general manager of American Cyanamid Co.'s Industrial Chemicals Division. Completion date for the facility has been set for the latter part of 1957, which is the company's 50th Anniversary Year.

Calciner, which will treat bauxite ore from the company's Quapaw deposit, will provide an increased supply of ore for the manufacture of aluminum sulphate at nine domestic Cyanamid plants.

CALIFORNIA

A Bakersfield, Kern County, drilling contractor moved late in February to drill the first in a series of three deep core holes in the Kramer area east of Boron.

Core holes will be drilled for the U. S. Geological Survey to augment a Government program to pinpoint surface and subsurface deposits yielding boron and other chemicals. In past months core holes have been drilled in the chain of dry lakes extending from Owens Lake to Searles Lake in the Mojave Desert.

Kern Uranium Co. plans to sink a 50-ft shaft to further evaluate its Little Sparkler claims in Kern Canyon, 36 miles northeast of Bakersfield. Exploration to date has resulted in the stockpiling of sufficient uranium ore to make a carload shipment. Company is negotiating with the AEC preliminary to shipment of the ore.

Yuba Consolidated Gold Fields, veteran San Francisco gold dredging firm with

½ DAY LOST IN 8 YEARS

Since he switched to GM Detroit Diesel Power

Working up to 9 hours a day, 6 days a week, in Robert Bailey's strip mine near Morrisdale, Pa., this General Motors Detroit Diesel-powered Bucyrus-Erie shovel has had total down-time of only *one-half working day in 8 years' operation.* Because of the dependable service and economy of this "6-71" engine, Bailey swung to GM Detroit Diesel power—now operates 9 units on generators, in tractors and in another shovel.

Does it pay to standardize on GM Detroit Diesel power? It sure does. For it simplifies your servicing and parts requirements. And, with power at *every* piston downstroke, these fast-stepping 2-cycle Diesels get more work done at less cost on any job.

You can have GM Detroit Diesel power (single engines, 30 to 300 h.p.; multiple units, up to 893 h.p.) in over 1,000 different applications of power machinery. For the list, see your GM Detroit Diesel distributor or dealer—or write us direct.

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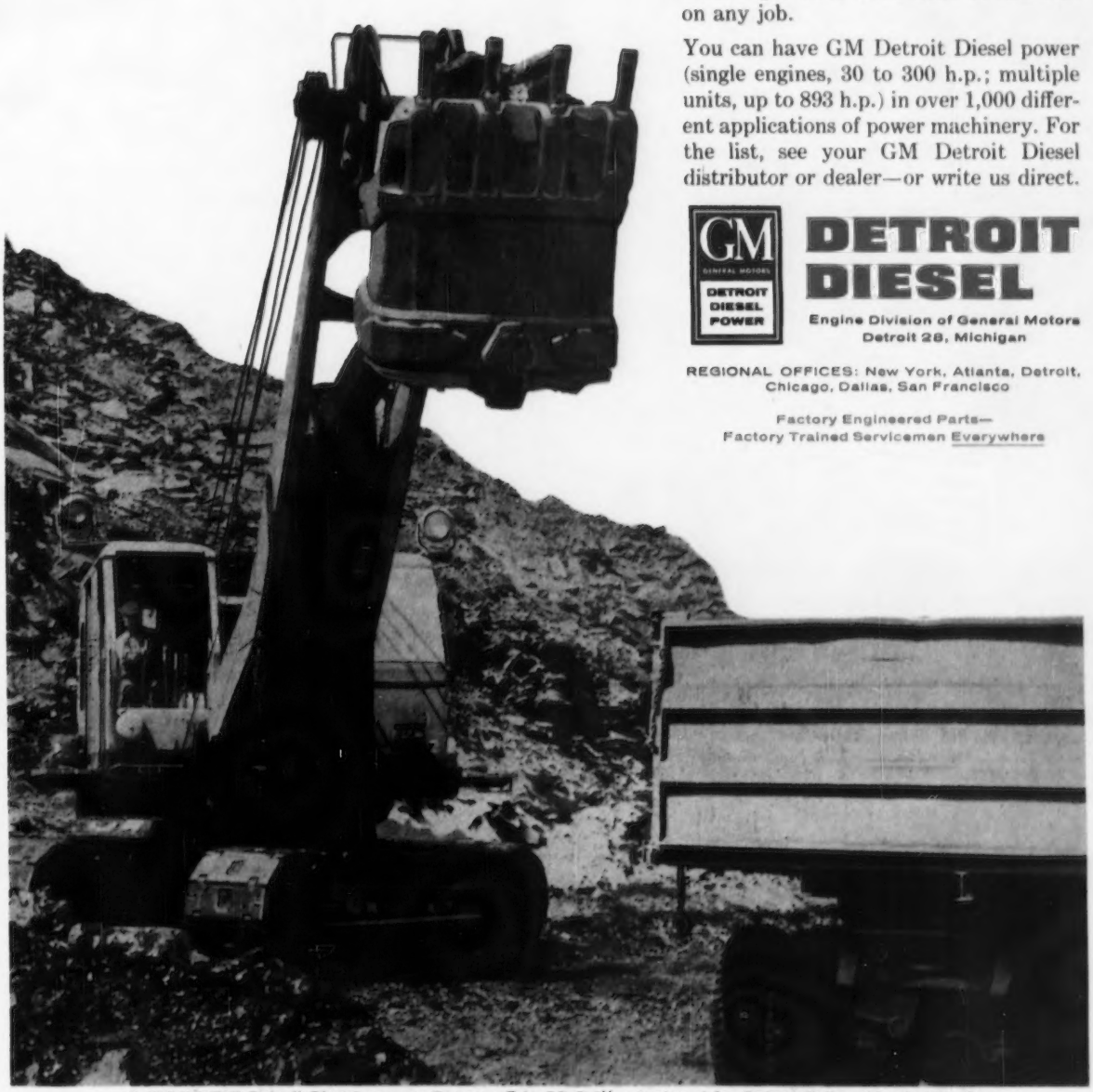
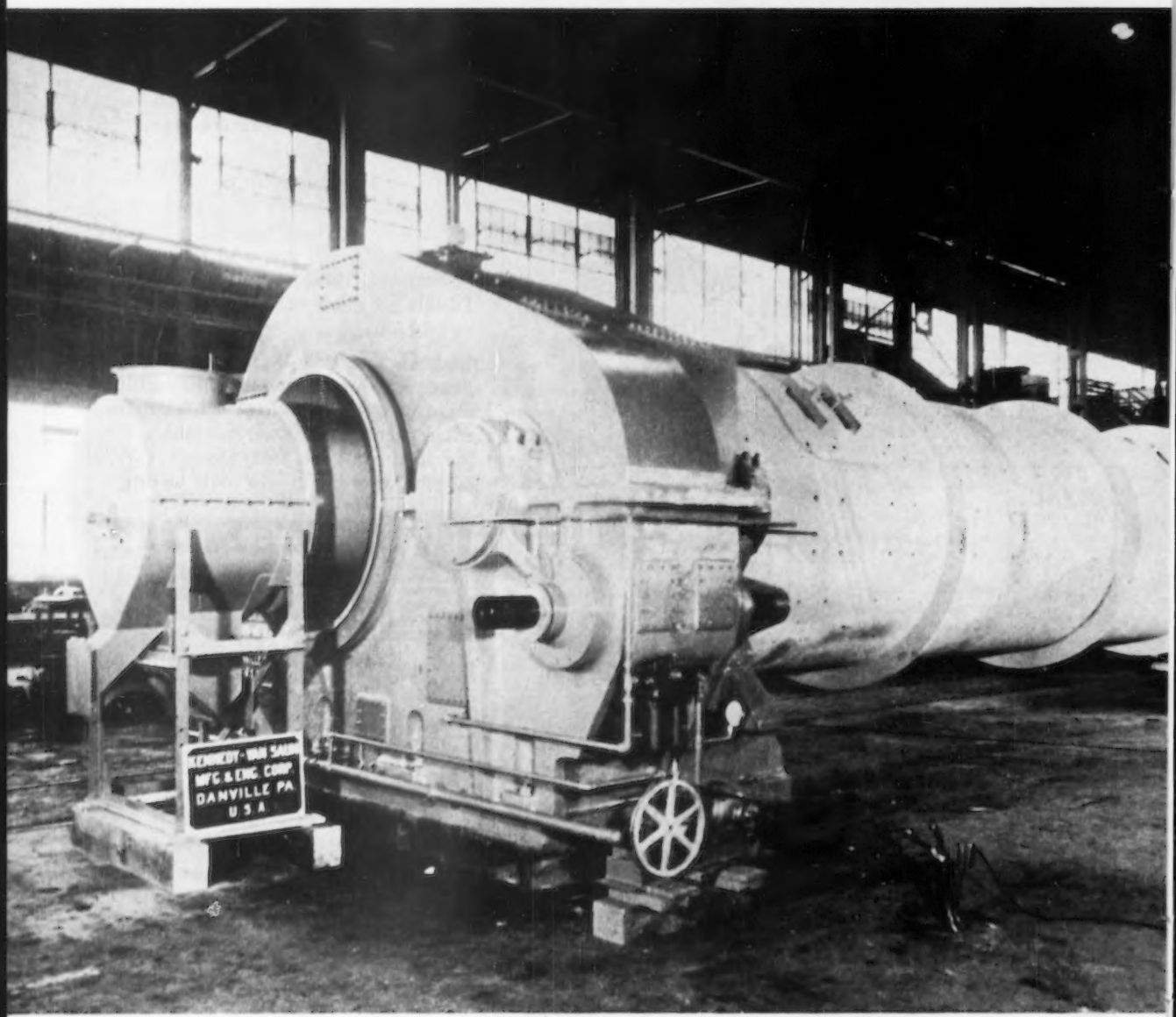


A GM "6-71" Detroit Diesel powers Bucyrus-Erie 38-B 1½-yd. shovel for Robert Bailey, Morrisdale, Pa.

KENNEDY GRINDING



ONE OF FIVE 8' X 36' KVS INTEGRAL GEAR DRIVE, 3-COMPARTMENT MILLS. BUILT FOR GRESIK CEMENT PLANT, ISLAND OF JAVA, INDONESIA.

FEATURES THAT DISTINGUISH KVS GRINDING MILLS

★ Cast Steel or Meehanite Heads ★ Welded and Stress-relieved Shells

★ Large Diameter Trunions ★ Self-aligning bearings with adjustable Sole Plates

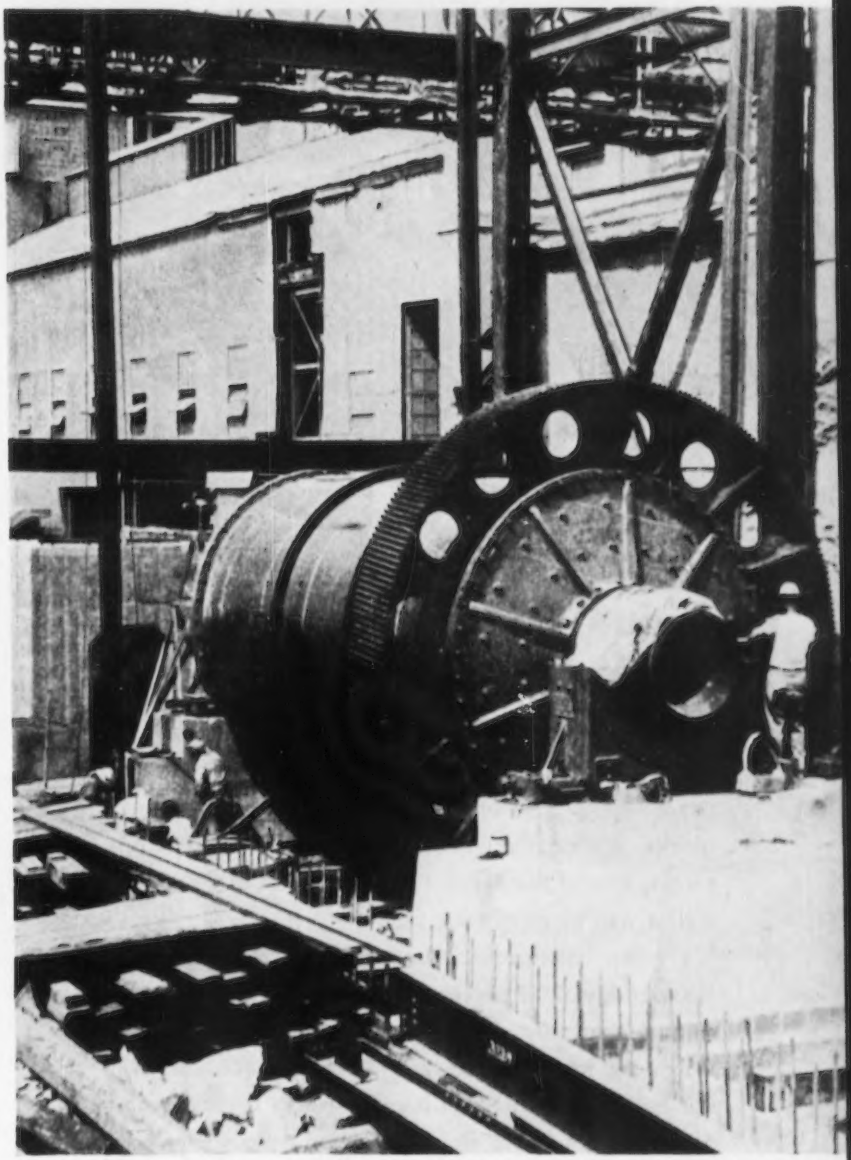
★ Ferris wheel lubrication for main bearings with oil-tight seals

LET OUR ENGINEERING DEPARTMENT FURNISH DATA ON ANY SIZE MILL FOR WET OR DRY GRINDING—

MILLS / *known the world over for performance and dependability . . .*

KENNEDY PRODUCTS

- Gyratory Crushers
- Swing Jaw Crushers
- Tube Mills
- Ball & Rod Mills
- Vibrating Screens
- Rock Feeders
- Air Swept Tube Mills
- Rotary Kilns
- Coolers, Dryers
- Preheaters, Deheaters
- Belts, Conveyors
- Pneumatic Transport Systems
- Waste Heat Boilers
- Pulverized Coal Firing Systems
- Steam Generators
- Asbestos Plants
- Complete Lime Plants
- Complete Cement Plants
- Complete Aggregate Processing Plants

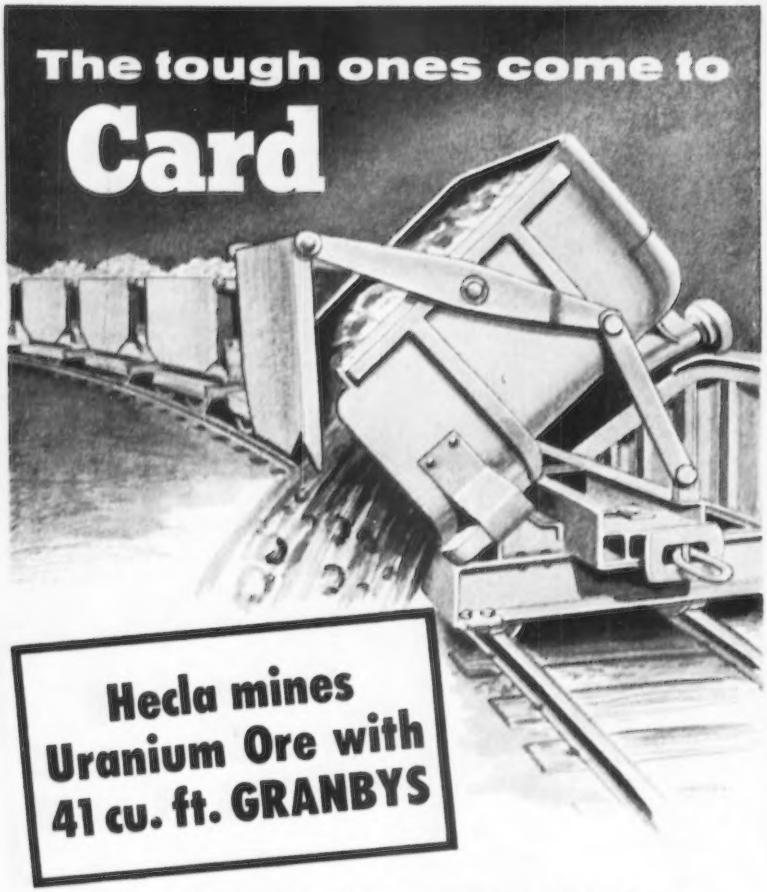


11' X 20' KVS CLINKER GRINDING MILL, SINGLE HELICAL RING GEAR, INSTALLED AT PETOSKEY, MICH., PLANT OF PENN-DIXIE CEMENT CORPORATION.

KENNEDY-VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

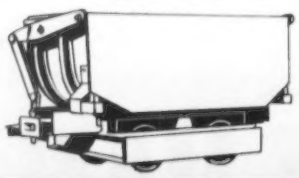
TWO PARK AVENUE, NEW YORK 16, N. Y. • FACTORY, DANVILLE, PENNSYLVANIA



Hecla Mining Company opened their Radon property with 20 small Granby-type Card cars designed specifically for this underground service. Hecla is operating one of the deepest uranium mines in the U.S.A. with a well planned mine plant.

The underground haulage involves up to 300 tons per day of 0.7 percent U_3O_8 ore. Each Card Granby car has a capacity of 41 cu. ft. and is built on 24" gauge. When the Radon orebody is exhausted, the cars will still be able to "outlive" another Hecla mine of comparable size without major repair or replacement.

Such haulage efficiency and long life are yours whenever your choice is Card. Our engineers are at your service on any production haulage problem.



C.S. Card Iron Works Co.
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DENVER, COLORADO

California *(Continued)*

operating properties in Northern California, has embarked on a policy of expansion and diversification.

This decision was announced by the firm's board of directors following a management reorganization that put John L. McGara in the president's chair.

First move in this direction affects the mining firm's subsidiary, Yuba Manufacturing Co. Yuba, which manufactures dredges and materials handling equipment and fabricates steel plate, has acquired ADSCO Industries, Inc. manufacturer of heat exchangers, expansion joints and fabricated steel items with plants at Richmond, Calif. and Buffalo, N.Y. ADSCO's various divisions will be operated out of San Francisco as divisions of Yuba Manufacturing. ADSCO is the firm McGara served as executive vice president before joining Yuba.

Meanwhile, Yuba Consolidated's board of directors disclosed it does not consider it economically feasible to mine the firm's deep reserves at the Hammonton, Calif. dredging operation. Value of these reserves was placed at $16-million by Col. R. E. Franklin, San Francisco consulting engineer.

Madera County Mining and Milling Co. opened its 300-tpd mill near O'Neals, for treatment of tungsten ores. The $300,000 facility will be operated by the company.

Some 40 men are at work at the historic Original 16 to 1 mine, one of the few Mother Lode gold mines still operating.

Mining is continuing at a rate that keeps the 100-tpd ball mill on the site operating at half capacity.

Only high grade ore—$30 to $50 per lb—is being extracted. The ore also contains a small percentage of silver.

Work is now under way on the 2400 level, under the direction of C. A. Bennett, superintendent, Two winzes—the 16 to 1 and the Tightner—are being employed, according to William M. Maxfield, vice president. The Tightner reaches maximum depth of the mine—2800 ft.

COLORADO

Twenty-two thousand tons of uranium ore was stockpiled as of Jan. 30 at the Los Ochos mine of Gunnison Mining Co., awaiting completion of the 250-ton mill to be built for that company this year.

Vance Thornburg, president of Gunnison Mining, said Western-Knapp Corp., which holds the construction contract for the $3-million mill, will begin work as soon as snow clears. Drilling of two water wells on the millsite near the Gunnison County airport was started early in February.

Leslie C. Ross, mine superintendent, said the Los Ochos property now has more than 2½ miles of cross-cuts, raises and drifts, and another 2½ miles of underground workings will be required to develop known ore reserves. Extent of the orebody still is not entirely defined, Ross said, and more drilling is planned this summer.

Now for the first time, a tungsten carbide insert bit, "drilled to destruction without the need of resharpening." Lower first cost, lower cost per foot drilled.

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(Photo courtesy Rocky Mountain News)

POKING THROUGH the late afternoon shadows, the historic train appears.

Climax Mines 100-Millionth Ton of Ore

COLORADO STATE AND COUNTY OFFICIALS and company representatives of Climax Molybdenum Co. from Denver and New York were present at Climax, Colo. Feb. 4 to celebrate what company president Arthur Bunker called "two important milestones—one reflecting past achievement and other attesting to our faith in the future."

Occasion was the mining of the 100-millionth ton of molybdenum ore at Climax and the start-up of the new No. 17 milling unit. Arrival of the historic ore train at the portal of the Phillipson Level lacked one month of coinciding with the date of the first ore train from the Leal Level 39 years ago.

Gov. Stephen L. R. McNichols pushed the start button on the No. 17 ball mill (13x12-ft) which will increase over-all plant recovery of molybdenum. The guests were later given a guided tour.

Colorado *(Continued)*

A uranium strike in San Miguel County in western Colorado was announced at Colorado Springs by E. J. Brittain, secretary of the Pikes Peak Uranium Corp. who said between 750 and 1,000 tons of the ore has been blocked out for working. Brittain said the ore assayed 0.78 radiometric and that a 475-ft long tunnel has just been finished to the orebody. Claude Blue is president of the company. John R. Maytag is vice president and Carl Burnett is a director.

Proposals for three small uranium processing mills in eastern Colorado, to handle Front Range ore, are being considered by AEC's Grand Junction Operations Office. The Front Range as yet has no mill and ore from mines on the eastern slope of the Rockies goes to Vitro's plant at Salt Lake City.

The new proposals are:

Cliff and Creek Uranium Co. of Colorado Springs, 125-ton mill in Pueblo County.

Cotter Corp. of Santa Fe, N. M., pilot plant operation to handle about 100 tpd near Canon City, Colo.

Uranium Extraction Co. of Denver, mill of 100 tpd or less north of Denver.

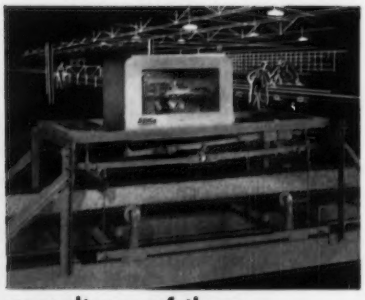
Southwestern Engineering Co., Los Angeles, has been granted contract for engineering and supervision of construction of Trace Elements Corp. mill to be built at Maybell, Colo.

J. F. Brenton, Trace Elements plant manager, said there will be no general contractor and that much work will be done by sub-contractors. Mill is scheduled for completion by Jan. 1, 1958. Trace Elements is a subsidiary of Union Carbide Nuclear Co.

Exploration of a thorium-monazite-columbian-tantalum deposit near Warm Springs, Custer County, Idaho, is planned by Alfred G. Hoyl of Denver, and associates. DMEA approved a $29,986 exploration project, with Government participation of $20,240.

Substantial reserves of lithium ore (lepidolite and spodumene) was proven by U. S. Lithium Corp. on its holding in the Quartz Creek area of Gunnison County. Over a thousand tons of ore was stockpiled from the drifts. The company has worked out the flow sheet for a concentrating mill and is now running pilot plant tests for a lithium salts plant. The main office of U. S. Lithium Corp. is in the Walker Bank Bldg., Salt Lake City, Utah. President of the company is Dr. Paul T. Walton. Resident engineer in charge of the Gunnison operations is Charles T. Vashus of Englewood.

Cold Spring Tungsten Mine, located less than two miles northeast of Nederland,



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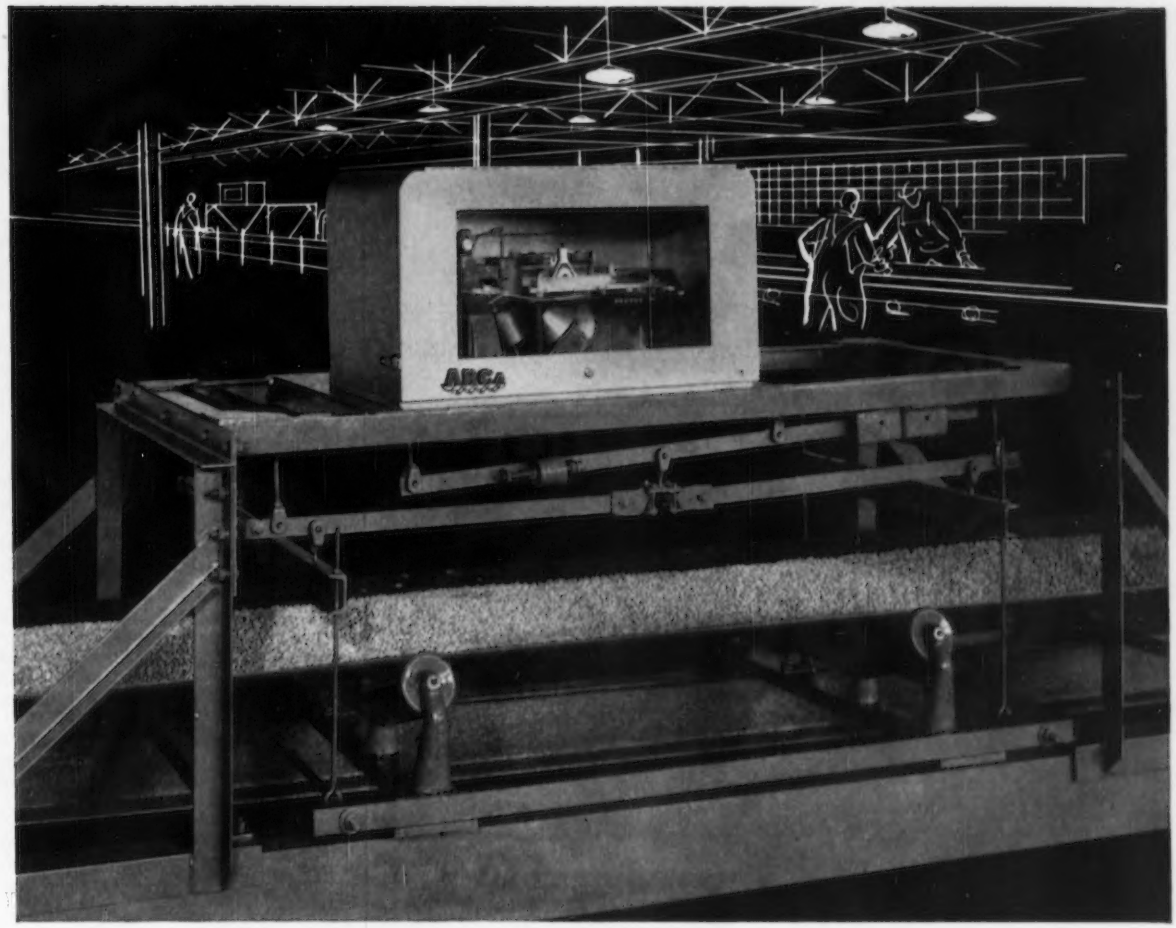

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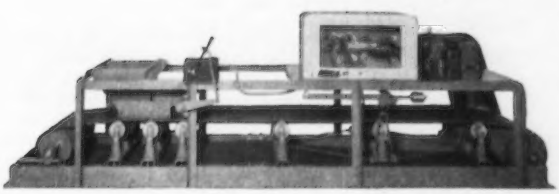

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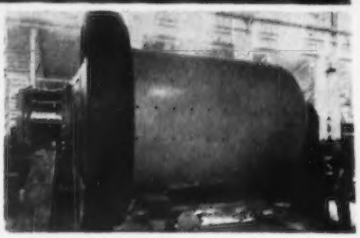
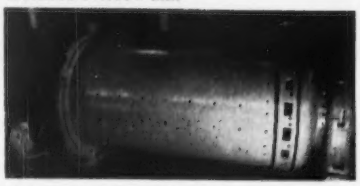
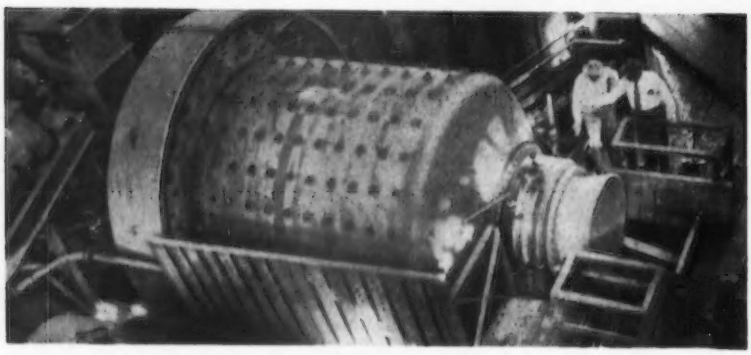


Trunnion overflow mill



End peripheral discharge mill

Center peripheral discharge mill



Exterior of 11½′ x 12′ Hardinge Rod Mill shown above

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Colorado *(Continued)*

carried on a continuous mining operation through last year. The mine was the largest single producer of tungsten in Boulder County. Ore from the mine was upgraded in a screening and sorting plant, and 4,039 tons of sorted ore were shipped to the company's mill in Nederland.

Eagle Mine at Gilman, Eagle County, operated by Empire Zinc Div. of the New Jersey Zinc Co., was Colorado's principal source of zinc during 1956. The mine was operated on a three-shift, 5-day basis throughout the year, and the underground concentrating plant shipped at the rate of about 4,000 tons monthly. About 500 men were employed throughout the year.

Gold receipts at the Denver mint in January topped January 1956 receipts, mint officials report. The monthly inflow was up to 64,665 oz worth $2,263,304 from 61,573 oz valued at $2,155,071. Silver receipts were down to 15,770 oz worth $14,292 from 17,718 oz valued at $16,023.

Regional office of U.S. Bureau of Mines in Denver reported in February that while lignite coals of North Dakota still offer promise as a source of uranium, no process has been developed to make extraction profitable.

The report said the AEC, Bureau of Mines and Ohio Oil Co. still are carrying on lignite research, and that progress is encouraging.

The report estimated North Dakota's mineral output in 1956 at $58,709,000, with oil production accounting for $38,490,000 of the total. The total figure represents a 22% increase over 1955.

General Mining Co. of Cortez is preparing to expand operations at the Lucky Day Uranium Mine of Robert M. Reel and J. H. Dyer, Associates, located in the Slick Rock Mining District of San Miguel County.

Approximately 1,000 tons of ore averaging 0.25% uranium and 3% vanadium have been shipped from the property to date. Drilling has established an ore reserve of approximately 2,000 tons which will be opened for mining in the near future. Dyer is in charge of operations at the mine.

Climax Molybdenum Co. is considering building a new by-products plant, Robert Henderson, resident manager, disclosed late in February. Final decision has not been reached, he added.

Major by-product of the Climax operation is tungsten, with about 50,000 lb recovered each month. Tin and pyrites are other by-products.

Rex Uranium Corp. shipped 9,918 tons of ore worth $275,535 in 1956, annual report of the company shows. Of the total income, $261,488 came from the Adak mine near Uravan and $7,313 from the adjoining Equinox claim. Rex also shipped ore worth $8,775 from its Bluebird mine in Dry Valley near Monticello, Utah.

Annual meeting of the Colorado Plateau Section, AIME, was held March 9 in

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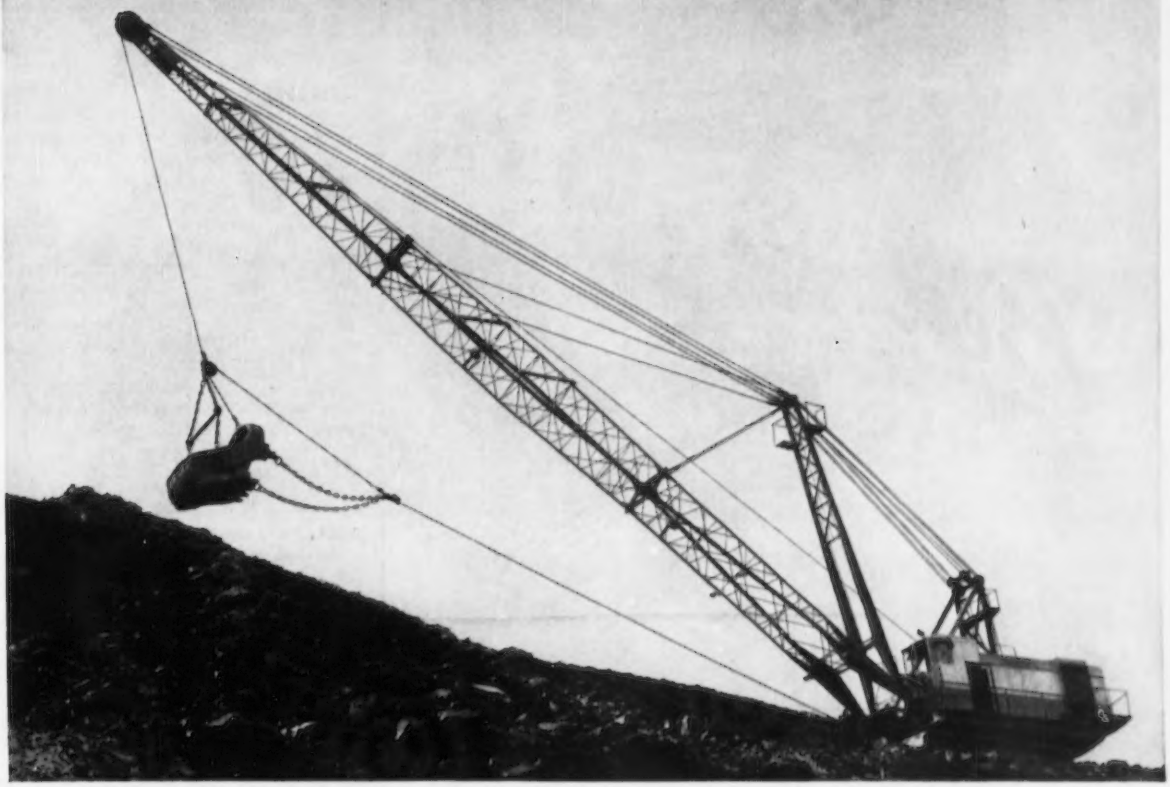

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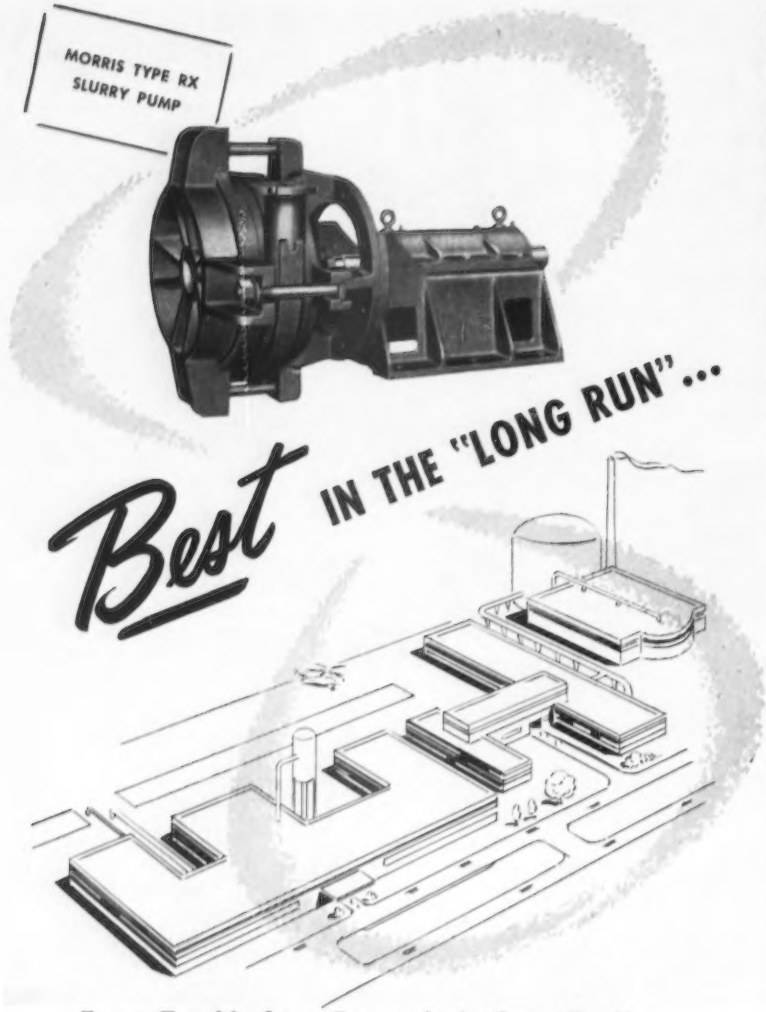

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Colorado *(Continued)*

Grand Junction. Program included presentation of a technical paper, "Slurry Pipeline as an Integral Link in Gilsonite Refining Project," by Lee Morris and John Henderson. Herb Reynolds and John Rosco showed a movie on Continental Uranium Corp.'s open pit mine near La Sal, Utah. A sound film on Canadian operations of International Nickel also was shown.

IDAHO

American Smelting & Refining Co. is getting underway with shaft-sinking operations at its Galena Mine west of Wallace to extend development on the silver-copper vein an additional 600 ft to the 4,000-ft level. A three-compartment winze will be put down at a 65-deg incline, following the southerly dip of the vein, at a point about midway between the ends of the 1,000-ft long ore shoot. The vein at this point is approximately 10 ft wide.

The winze site is about 1100 ft easterly from the main vertical shaft which extends from the surface to the 3400-ft level.

A double-drum hoist from the recently-closed Frisco Mine will be used for sinking operations, and a Cryderman shaft-mucker will do the mucking.

Several new levels will be opened off the winze.

The silver-copper vein was first opened on the 3,000-ft horizon, and the ore shoot proved to be 700 ft long at this elevation. It has since been developed upward to the 2200 level and downward to the 3400.

The Galena Mine is owned by Vulcan Silver-Lead Corp. and operated by AS&R under a long-term lease and profit-sharing agreement. Day Mines Inc. holds a 25% interest in the lease. Norman Visnes is general superintendent of the Galena operation, under J. C. Kieffer, general manager of Asarco's northwest mining department.

Central Farmers Fertilizer Co-op. of Chicago has started preliminary work on a $10-million phosphate operation at Georgetown Canyon in Bear Lake County, it was announced recently by Joseph L. Lanter, president. Stripping of overburden from the organization's 2,400-acre phosphate deposit has been started, to prepare an open-pit operation of about 1,500 tpd, and crews are also engaged in constructing an access road and railroad grade through the narrow canyon to the plant site near the deposit. A spur track from the Georgetown station is expected to be completed in time for hauling heavy materials to the plant site. F. C. Torkelson Co., a Salt Lake City engineering firm, has been retained to design and supervise construction of the plant which will produce calcium metaphosphate and other phosphate products for distribution to the 15 regional co-operatives in the midwest which are members of Central Farmers. Charles M. Miller, former employee of Monsanto Chemical's phosphate plant at Montpel-

BIGGEST PRODUCER in the 1½-yd. class!

New 80 HP tractor-shovel moves up to 40% more yardage per shift!

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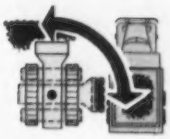
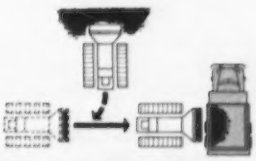


With Case-TerraTrac 800 . . . Operator picks up load smoothly . . . flips two hydraulic levers and steps on foot throttle, to spin tractor over a center point into position for dumping, with *one 90° counter-rotating turn.* Then he simply reverses two levers and makes one NON-STOP 90° turn back to pile in seconds. Result: Each cycle is completed with minimum lost time, minimum travel distance, and minimum operator fatigue.



With conventional crawler-loader . . . Operator rams into pile . . . de-clutches . . . hand shifts into reverse . . . uses hand throttle and brake, to turn and back away. Then he has to de-clutch . . . stop . . . hand-shift and move forward again to dump. What's more, he has to go through the same complicated procedure *in reverse,* to pick up his next load. Result: He usually travels twice as far . . . takes more time to complete each cycle . . . gets twice as tired before end of day . . . just working his hands and feet.

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Idaho *(Continued)*

ier, is the Co-op's director of manufacturing in Idaho.

Black Bear Silver-Lead Mines Co. has applied for a lease on the four claims of the recently-closed Frisco Mine property through which the main Black Bear adit tunnel passes in reaching the Black Bear property. Earlier plans for leasing the Frisco workings above the 1600-ft level were abandoned when the property was permanently shut down Jan. 1 by AS&R.

The four claims can readily be prospected and developed from the Black Bear adit.

The Black Bear firm is an affiliate of Metropolitan Mines Corp. which has a controlling stock interest.

Abot Mining Co. of Wallace was incorporated in February with a capitalization of $1-million. Incorporators were Henry L. Day, president of Day Mines Inc., L. J. Randall, president of Hecla Mining Co., R. W. Anno and Leo K. Kraemer, all of Wallace, and Wray D. Farmin of Spokane.

E. L. Jones & Associates of Weiser are currently installing an iron concentrator at their iron mine on Iron Mountain in Washington County and will erect a "briquette" plant at Weiser this summer, with the eventual objective of producing pig iron by the "hydrogen" process in Weiser.

A conventional blast furnace is not practicable in the Weiser area, president Earl L. Jones said, because of the lack of low-cost coke and because of the high initial investment involved.

Supplies of ore at the mine 35 miles north of Weiser are considered ample for a long-term operation and the deposit is readily adaptable to open-pit methods. Ore is reported to be of superior quality, consisting mainly of magnetite running as high as 70% iron.

ILLINOIS-KENTUCKY

Reopening of the Pigmy fluorspar mine at Mexico, in Crittenden County, Ky., which has been shut down for the last five years, is announced by Rosiclare Lead and Fluorspar Mining Co. It is expected to be back in production this month. Pumping out processes, re-timbering, and installation by Kentucky Utilities Co. of a new power line into the site were in progress during February. For many years the Pigmy was a steady producer of metallurgical grade fluorspar.

Humm Mackey—Hicks Creek Fluorspar Mining Co. is installing a fluorspar flotation plant at its property in Hardin County, Ill., near the "Wye," 6 miles west of Elizabethtown. Equipment was purchased from Inland Steel Co., which suspended its fluorspar operation several years ago, and moved from Kentucky to the Illinois site. A heavy media separation plant was installed in 1955.

The newly organized Greene Fluorspar Co. is sinking a 300-ft rectangular shaft on the Ora Spivey property in Hardin

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96.7% CORE RECOVERY

IN POORLY CONSOLIDATED FORMATIONS

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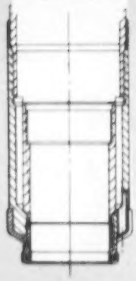

Core recovery in the Gas Hills of Southwestern Wyoming was only 40 to 60 percent, proving a major problem to drillers. This very low return was first attributed to the failure of core catching devices to hold core in the inner tube. After considerable trial and error with every type of core catching equipment the Christensen engineer became convinced that the circulation fluid was actually washing away the friable and poorly consolidated uranium bearing sediments before they entered the inner tube.

With all the facts and actual job experience, Christensen then adapted the 4½" x 3" core barrel for use with a long nose or pilot type diamond set core bit. This allowed the driller to actually core *ahead* of circulation.

The new barrel and bit design by Christensen, together with proper fluid and volume controls, gave impressive results.

1. Total coring has yielded 96.7% recovery.
2. *All* units of the formation have been cored successfully.
3. An average of 25 feet of core is obtained per drill shift.
4. Combined cost of diamond bit and core barrel, $2.31 per foot, considerably lower than previous averages.

Discuss your coring problems with the Christensen engineer. There is almost always an existing design for any situation, if not, Christensen can adapt one for your needs.

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LESS COST PER FOOT CHRISTENSEN Diamond Products

1937 SOUTH 2nd WEST SALT LAKE CITY, UTAH

Ill.-Ky. *(Continued)*

County. Work is under contract to J. W. Patton and Sons, Elizabethtown contractors. Five drill holes revealed a good showing in a vertical vein, located on Rock Creek, north of the Hobe fluorspar mine. Edward Greene is president of the new company.

Approximately 60% of the total shipment of 325,000 tons of fluorspar by U. S. producers in 1956 was produced in the Ky.-Ill. mining district, according to figures submitted by J. Blecheisen, president of Rosiclare Lead and Fluorspar Mining Co. in remarks before the Colorado Mining Association in Denver. The report, reviewing the fluorspar industry in 1956, showed that the Ky.-Ill. region, which has been the largest fluorspar-producing area in the country for more than 75 years, has at present the following major producers: Pennsylvania Salt Manufacturing Co., Aluminum Co. of America, Ozark-Mahoning Co., Minerva Oil Co. Fluorspar Division; Humm Mackey-Hicks Creek Fluorspar Mining Co., Rosiclare Lead and Fluorspar Mining Co., and Kentucky Fluorspar Co.

Last year the Illinois area alone showed approximately 100,000 ft of exploratory drilling done by the major companies. The Defense Minerals Exploration Administration certified two exploratory projects in Ill. and Ky.

Penn Salt opened its new Dyers Hill shaft in 1956 and now is mining and milling fluorspar for use in the manufacture of hydrofluoric acid at its Calvert City, Ky. plant.

In November 1956 the U.S. Geological Survey released the results of its latest study on fluorspar reserves in the U. S., reporting approximately 22.5-million tons of ore of 35%-plus grade and approximately 12-million tons of 15% to 35% grade. The new reserves estimate is substantially greater than the 1944 estimate.

The Government began its metallurgical grade stockpiling program in the summer and acid grade program in the fall of 1956.

MICHIGAN

North Range Mining Co. has arranged with Pickands, Mather & Co. to treat 100,000 tons of low grade ore from the Fortune Lake mine lean ore pile, at North Range's Book mine washing plant. The truck haul between the Fortune Lake mine near Crystal Falls and the Book mine plant at Alpha is about 4 miles. Pickands, Mather & Co. has finished mining at the Fortune Lake except for stock-pile shipments in 1957.

February meeting of the Lake Superior Mines Safety Council held at Ironwood Feb. 7, was attended by 133 members. E. P. Govednik, Ironwood, of PM&Co., was chairman of the meeting. Among the papers given were: "Prevention of Fall-of-Ground Accidents" by J. B. Stepan, U. S. Bureau of Mines; "Minimizing Electrical Fires Underground" by James Thomas of Montreal Mining Co.; "Hazards of Blasting Caps" by R. C. Sherman,

"Here's why we prefer International Drott in the pits..."

"Plenty of room and comfort," says operator Lawrence Rutherford for Hoosier Lime and Stone Co., Salem, Indiana. "This TD-9 is faster, easier to operate and vision is much better." He commands full 41° *ground-level* bucket roll-back to heap the bucket, every time. Semi-skid method gives him fast load transport on exclusive skid-shoes. Exclusive level raise action all the way up helps "keep the heap" till he dumps.

"A powerful, smooth-operating loader," declares owner-operator L. D. Lynch of Grand Blanc, Mich. "Hydro-Spring really makes a difference in operator comfort and machine protection." Exclusive Hydro-Spring is a hydraulic cylinder connected to the main lift system enclosed in a heavy-duty locomotive-type coil spring—to swallow slam-bang shocks—protect equipment and hydraulic hoses.

"My experience with seven International crawlers has been mighty good all the way," says owner-operator Paul Bryson of Hazelwood, N. C. "My old TD-9 has 10,000 hours on the meter." Such performance is behind his recent purchase of a new bonus-powered TD-9 Skid-Shovel®. He gets the original pry-action break-out force with triple the digging power of ordinary front-end loaders!

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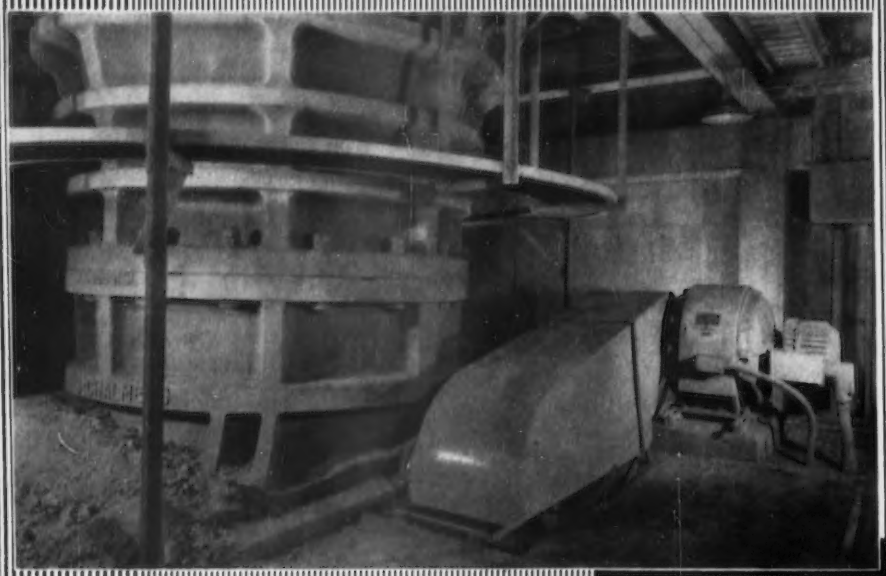
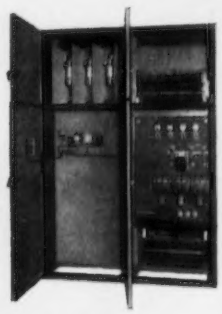




Crushing

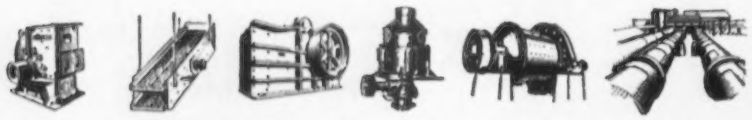
An example of Allis-Chalmers "coordineering" is this crusher installation. Drawing on 75 years' experience in building and applying crushers, Allis-Chalmers control and crushing engineers developed a control circuit designed to cut costly downtime for the crusher installation shown above. In this circuit, motor overload protection is provided by *two* sets of thermal overload relays. One set operates at slight overload to sound warning. The second set stops the motor when temperature reaches the danger point.

Because of high starting torque and frequent starting under load, an Allis-Chalmers wound-rotor motor is used. In calculating horsepower requirements, the factors of crushability, ratio of reduction, product size and specific gravity are evaluated.

Flexibility in the Crusher

The crusher is the *Superior* gyratory crusher which features "one-man, one-minute" positioning of mainshaft and mantle. This control facilitates emptying crushing chamber in case of power failure or other emergencies. It also compensates for wear on concaves and mantle and, when required, changes product size instantly. In Allis-Chalmers gyratory crushers, changing eccentricity, speed, or shape of chamber varies capacity and product size. This flexibility permits synchronizing crushing with other operations.

Superior is an Allis-Chalmers trademark.



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ALLIS-

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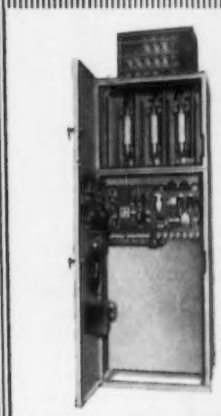
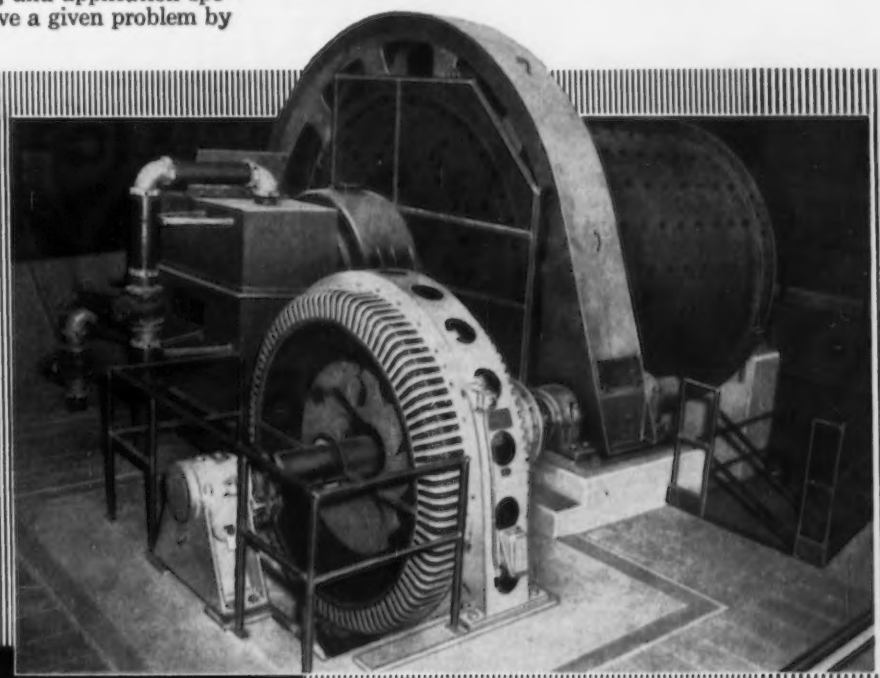
Results for You!

of processing machinery. In addition, the company manufactures complete lines of electrical generation, distribution and utilization equipment. As a result, Allis-Chalmers has a tremendous reservoir of experience—a most diversified team of research, engineering, manufacturing and application specialists — specialists who solve a given problem by exchanging ideas and correlating specific know-how and skills.

Only Allis-Chalmers can give you truly integrated equipment — because only Allis-Chalmers can give you "coordineering."





Grinding

In solving a grinding application, requirements and variables are given a careful going over by an Allis-Chalmers team comprised of *grinding*, *motor* and *control* engineers. Characteristics of material, capacity, feed preparation, balance of gradations, torque characteristics, system power factor needs, control requirements are some of the many factors evaluated. Experience has proved that this thorough pre-application investigation and preparation pays off to the purchaser . . . *pays off in providing a modern, efficient grinding circuit with the lowest operating cost.*

An Integrated Grinding Mill Installation

In a typical application, the mill installed was a 10½ by 12-foot Allis-Chalmers diaphragm ball mill. The close diameter-length ratio is an important factor in producing the highest possible capacity per unit of power. Driving the mill is a 900-hp, 4000-volt, 257-rpm, 0.8 pf Allis-Chalmers synchronous motor. By providing desired power factor correction, this motor reduces power cost. The Allis-Chalmers starter is specially engineered to provide protection under all conditions of grinding operation. A-4915

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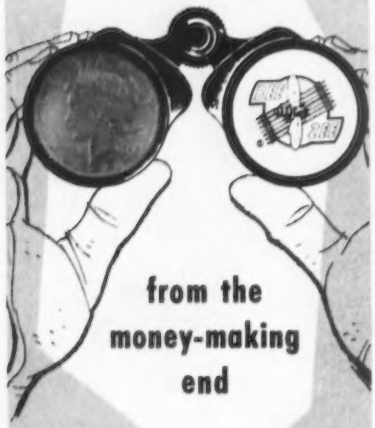
BEE-ZEE
SCREENS



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ruggedest accuracy

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Michigan *(Continued)*

du Pont Co.; "Development in Safety" by Thomas Richards, Reserve Mining Co. and "Driving a Vertical Raise by Use of a Cage," by J. C. Wangaard of PM&Co.

Algoma Ore Properties, Ltd., Michipicoten iron range, Ontario, shipped 1,361,763 tons from its Helen-Victoria mine operation in 1956. Algoma is also developing the Sir James mine, ore from which will be hauled by a two-mile aerial tramway to their sintering plant at Jamestown.

Penokee mine at Ironwood, Gogebic Range, which North Range Mining Co. acquired from Republic Steel in 1955, shipped 445,864 tons in 1956, its largest production since 1948 when it made 576,937 tons. North Range's Warner mine on the Menominee Range was also a good producer with 166,235 tons. In June 1956, work was begun on sinking the Warner shaft to open up the 14 level.

Montreal mine of Oglebay, Norton & Co. at Montreal, Wis. on the western Gogebic Range, had its smallest production for at least 10 years: 855,807 tons. Though this was largely due to the steel strike of 1956, it was less than the 948,961 tons of 1952 when production was also affected by a long strike. The Montreal has been a large producer for well over 50 years.

MINNESOTA

Rhude & Fryberger, from two Mesabi Range and three Cuyuna Range mines, shipped a total of 584,592 tons in 1956. Largest producer was the Boeing at Hibbing, a former underground mine operated by Cleveland-Cliffs Iron Co. 1922-1927. It produced 2,711,449 tons during those years. Operation was taken over by Rhude & Fryberger in 1953. It was stripped and has shipped a total of 1,425,200 tons as an open pit. 344,655 tons of this was produced in 1956. The other producers were the Troy mine on the eastern Mesabi Range and the Pennington, Carlson-Nelson and Hillcrest stockpile on the Cuyuna Range.

Zontelli Bros., with a total of 386,294 tons shipped in 1956, again produced from four ranges: the Cuyuna and Mesabi Ranges of Minnesota and the Gogebic and Menominee Ranges of Michigan. The six mines on the Cuyuna shipped 264,214 tons. The other ranges, with one mine each, produced the balance of 122,080 tons.

AIME Minnesota Mining Sub-Section and the Lake Superior Geology Club held a joint meeting at Hibbing Jan. 30. Bert Boyum, chief geologist for the Cleveland-Cliffs Iron Co., gave a talk on "Mine Geophysics" which emphasized methods now used by mining companies in exploration and mining.

Oliver Iron Mining Division's 1956 shipments of iron ore were all from the Mesabi and Vermilion Ranges of Minnesota: the Hibbing-Chisholm district, now entirely open pit; the Canisteo district, also all open pit; and the Virginia-Eveleth district which includes the Pioneer and Soudan underground mines on the Vermilion Range. Oliver is the only one of the three largest operators not active on any of Michigan's ranges.

Total shipment of 29,069,696 tons exceeded that of the combined output of the second and third operators by more than 5-million tons. Oliver had nine properties which shipped more than 1-million tons each. Sherman group near Chisholm lead with 5,727,793 tons and the Rouchleau-Sauntry at Virginia was a close second with 5,212,154 tons. The Hull-Rust at Hibbing, leader for many years, was third with 3,282,332 tons.

The Pilotac taconite plant at Mt. Iron produced 676,797 tons of concentrates. The Monroe group at Chisholm, active since 1905, was still a large producer with 2,287,916 tons, making it fourth in Oliver's list.

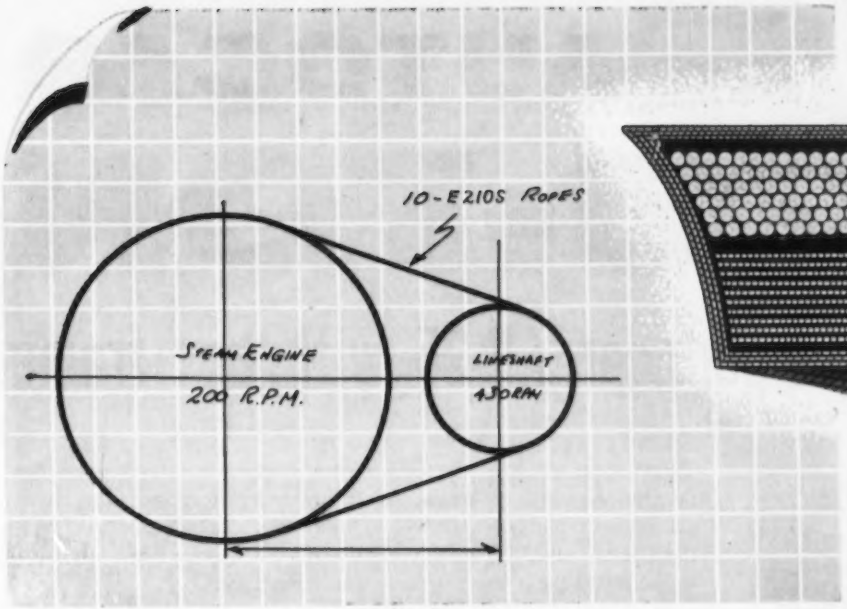
Snyder Mining Co. has begun hiring men for its Godfrey mine, recently taken over from Oliver Iron Mining Division. Some ore is now being hoisted. Pumping has been continued at the mine and much necessary equipment was left in place when Oliver discontinued mining. Snyder plans to ship some 200,000 tons from the mine in 1957. Harry Haller is superintendent in charge.

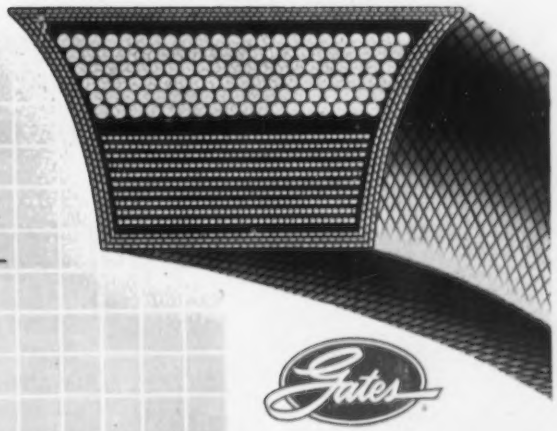
Meadow mine at Aurora, eastern Mesabi Range, is being stripped by Pacific Isle Mining Co. for the Pittsburgh-Pacific Co. and will be reopened as an open pit for the 1957 season. The Meadow and adjoining Fowler mine were formerly operated by Inter State Iron Co. (J&L Steel Corp.) as an underground property: the Fowler from 1907 to 1914 and the Meadow from 1910 to 1915. Both properties were operated by Cleveland-Cliffs Iron Co. 1916 to 1922. Last shipments from the mines were made in 1922. Total production from the Meadow 448,448 tons and from the Fowler, 926,196 tons.

Pacific Isle's stripping program may also include the Fowler. Both mines have been listed as "exhausted." A crushing and screening plant is planned for the pit and the ore will be concentrated at the Coons-Pacific plant near Eveleth.

The Enterprise, Portsmouth, South Agnew and Spring Valley mines of the M. A. Hanna Co. completed a year without a lost time accident. The employes of these mines received first awards under the group safety program. A total of 929,450 man-hours were worked at the four mines.

Cleveland-Cliffs Iron Co.—fourth largest producer for 1956, following Oliver, M. A. Hanna Co. and Pickands, Mather & Co., shipped 8,400,790 tons—about 1.4-million tons less than in 1955. The Mather mine on the Marquette Range of Michigan was, as usual, Cliff's first producer with 2,339,678 tons. The Humboldt mine, Michigan's first producer of jasper concentrates, shipped 212,487 tons. Republic, six miles south of the Humboldt, did not enter the shipping list in 1956.





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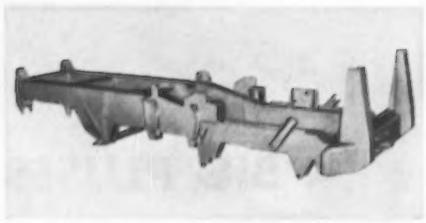
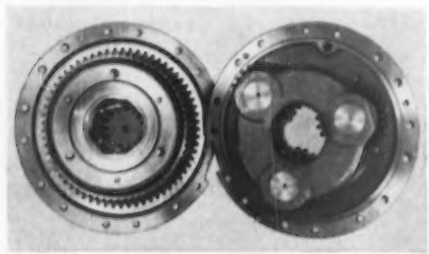


The torque-resisting box frame

Cutaway view of frame showing corrugation



Hub end of rear axle, with view of planetary gears

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You have a choice of two rugged turbodiesels developing 335 and 375 hp. Maximum torque is 900 and 942 lb. ft.

A Planetary-Gear Rear Axle

The AP-25 is built to endure. The planetary-gear rear axle with final reduction at outer ends of rear wheels minimizes torque loads on differential and axle shafts, provides much longer gear and shaft life.

A Torque-Resisting Box Frame

This brand-new frame is designed to be the strongest and most rigid in off-highway operation. Of all-welded construction, it has a variable-depth box section (maximum depth 18½ in.), reinforced internally for its full length by a heavy corrugated plate which is plug welded to alternate sides at intervals of 15¼ in., and is also welded to the tension member. The whole frame is made out of ⅝ in. plate and

Autocar

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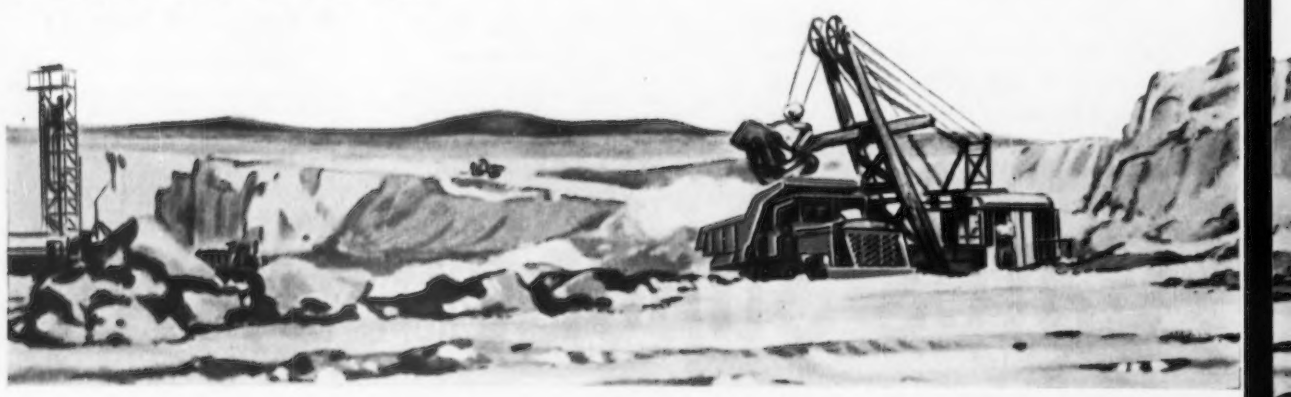
Autocar Division of The White Motor Company • Exton, Pa.



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and planetary-gear rear axle for tough hauling

weighs more than 7200 lb. It will resist the most severe torsional loading.

An Offset-Mounted Cab

The cab is specially designed for off-highway service. Ruggedly constructed of heavy gauge sheet metal, it is mounted in an offset position. The left half of the cab takes up the full depth, thus providing ample space for the driver, but the right half is cut back to allow the cab to be moved forward on the chassis. This position enables the wheelbase and overall length to be reduced by 11 in., and thus provide increased maneuverability. A 2-way adjustable steering column (2 in. range in height, 15° arc forward or backward), and "Full-Adjust" Driver's Seat allow the driver to select his most comfortable position.

Choice of Mechanical Transmission or Torque Converter

The mechanical (Road Ranger) type of transmission provides nine properly spaced speeds (all but one on a single gearshift lever). The wide range of gear ratios assures exceptional low-speed performance, as well as high maximum speeds. The optional torque converter and planetary-gear transmission permit the driver, while under full power and full load, to shift without changing the throttle setting. A Torqmatic brake and direct drive lockup clutch offer the ultimate in control, safety and brake lining life.

There are many other features to this massive new Autocar. For full information on what the Autocar AP-25 can do to lower operating costs and increase volume, contact your nearest White-Autocar distributor.

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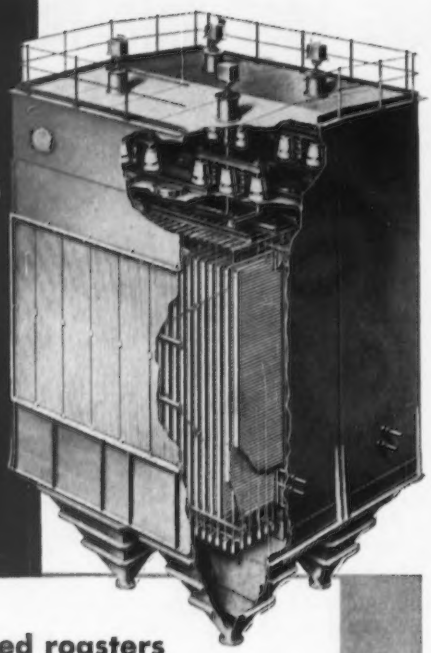

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Michigan *(Continued)*

Cleveland-Cliffs is the only one of the larger companies to ship more ore from Michigan than from Minnesota: (all Minnesota ore came from the Mesabi Range) 4,684,622 tons and 3,716,169 tons respectively. Largest Minnesota shipper: the Canisteo at Coleraine, 993,816 tons.

Iron ore sintering facilities are being rapidly expanded in the country's iron areas. Eighteen new sintering machines with an annual capacity of over 25-million tons are to be completed during 1957. Together with the 103 machines now in use, the new equipment will bring total national sintering capacity to 63-million tons per year.

W. S. Moore Co. in 1956 shipped 486,-828 tons from nine Mesabi Range properties. No. 1 shipper was the Judson near Buhl with 258,035 tons as compared to 309,371 tons in 1955. Since the first shipment in 1951, the Moore Co. has produced 1,159,388 tons from the Judson.

Haley-Young Mining Co. shipped 198,-012 tons in 1956. Elbern mine, which was opened in 1948, had the largest tonnage: 122,877 tons. Including 1956, the mine has produced 1,037,154 tons. The company's new Running Wolf property in Montana shipped 3,376 tons.

St. James Mining Co., only operation of Oglebay, Norton & Co. on the Mesabi Range, produced 328,960 tons from its St. James mine at Aurora in 1956, against 405,233 tons in 1955.

Oliver Iron Mining Division's 37th annual general safety committee meeting was held in Virginia Feb. 20. About 160 supervisors and safety engineers from all Oliver's Mesabi Range districts attended. Company's 1956 accident frequency rate was the lowest since 1941. Safety talks, a motion picture, "The Margin of Safety," and a message from president R. T. Elstad occupied the day with a luncheon at noon.

MONTANA

Richard Setterstrom, an official of the Montana Power Co., Butte, told the Chamber of Commerce in Shelby that Anaconda Co. will prospect for copper in the Sweetgrass Hills, near Shelby.

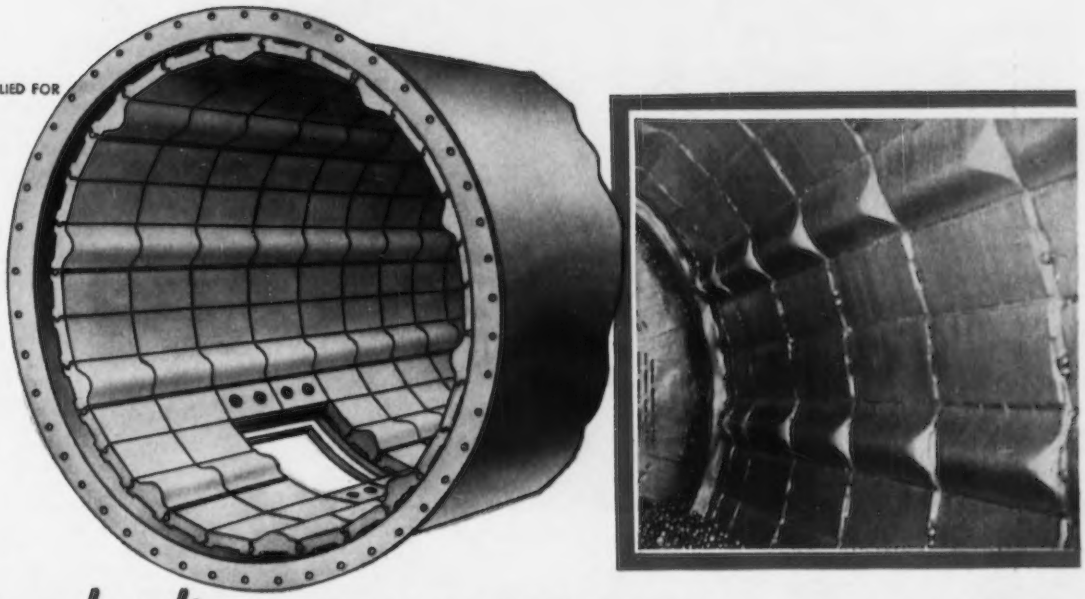
He read a memorandum from Chester H. Steele of Butte, Anaconda vice president in charge of western operations which stated:

"The Anaconda Co. is planning definitely on conducting an extensive prospecting and development program in the area on and near the copper ore discovery made by Vernon Moulton, L. R. Hannah and Cedor B. Aronow near Whitlash.

"The greater part of the area is covered by a thick mantle of slide rock and present plans are to make use of bulldozers to remove overburden of exposed bedrock and possible orebodies.

"Extent of the development work will depend upon the discoveries made in 1957. Every effort is going to be made to

PATENT APPLIED FOR



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B&W LINER PLATES RAISE PERFORMANCE, LOWER COSTS

The new B &W Tube Mill Liners have advantages that mean reduced costs in capital, time and labor.

Cost per ton of material ground is reduced, for the practical reasons listed below. Check them—you may find that one, or a combination, of these qualities will solve your existing problems.

- Lower Initial Costs—No pattern and chiller costs —the result of standardization.
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Liners are supplied in two nominal thicknesses, 1½″ and 3″ with 1½″ high lifters. Castings are 6″ wide x 12″ long. Positive seating of small castings on mill shell means less breakage of castings under operating conditions. For additional information on B&W Universal Tube Mill Liner Plates, write The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.

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Montana *(Continued)*

determine the possible existence of orebodies in this area.

"Much work is planned, and if successful, it will mean an entirely new enterprise which will prove beneficial to the whole northern Montana community."

NEVADA

Fire at the 1800-ft level of the Nevada Massachusetts mine at Tungsten, Pershing County, burned for three days late in February before it was brought under control. The blaze started on a day the mine was idle and was discovered the next day. It was brought under control by five men working under direction of Mervin Gallagher, state mines inspector. Working with self-contained breathing units, the men used timbers, canvas and mud to seal off the vertical mine shaft 60 ft below the 1700-ft level. It was the first serious fire in a Nevada mine since 1949, and is believed to have been started by short circuited wiring or by a carelessly discarded cigarette. H. J. McCreary, of the U. S. Bureau of Mines in Reno, was called to the site, and took with him needed mine rescue equipment. The Nevada Massachusetts property is one of the nation's largest tungsten producers, and one of Nevada's largest mining operations.

Monarch Milling and Mining Co. is now treating an average of 40 tpd cinnabar at its plant in Goldfield, which was formerly operated by the Newmont Mining Corp. Ore is coming from the Monarch Co.'s property near Ione. Ten men are employed at the mill under direction of L. C. Penhoel, metallurgist, and four men are working at the mine situated 90 miles north of Goldfield in Nye County.

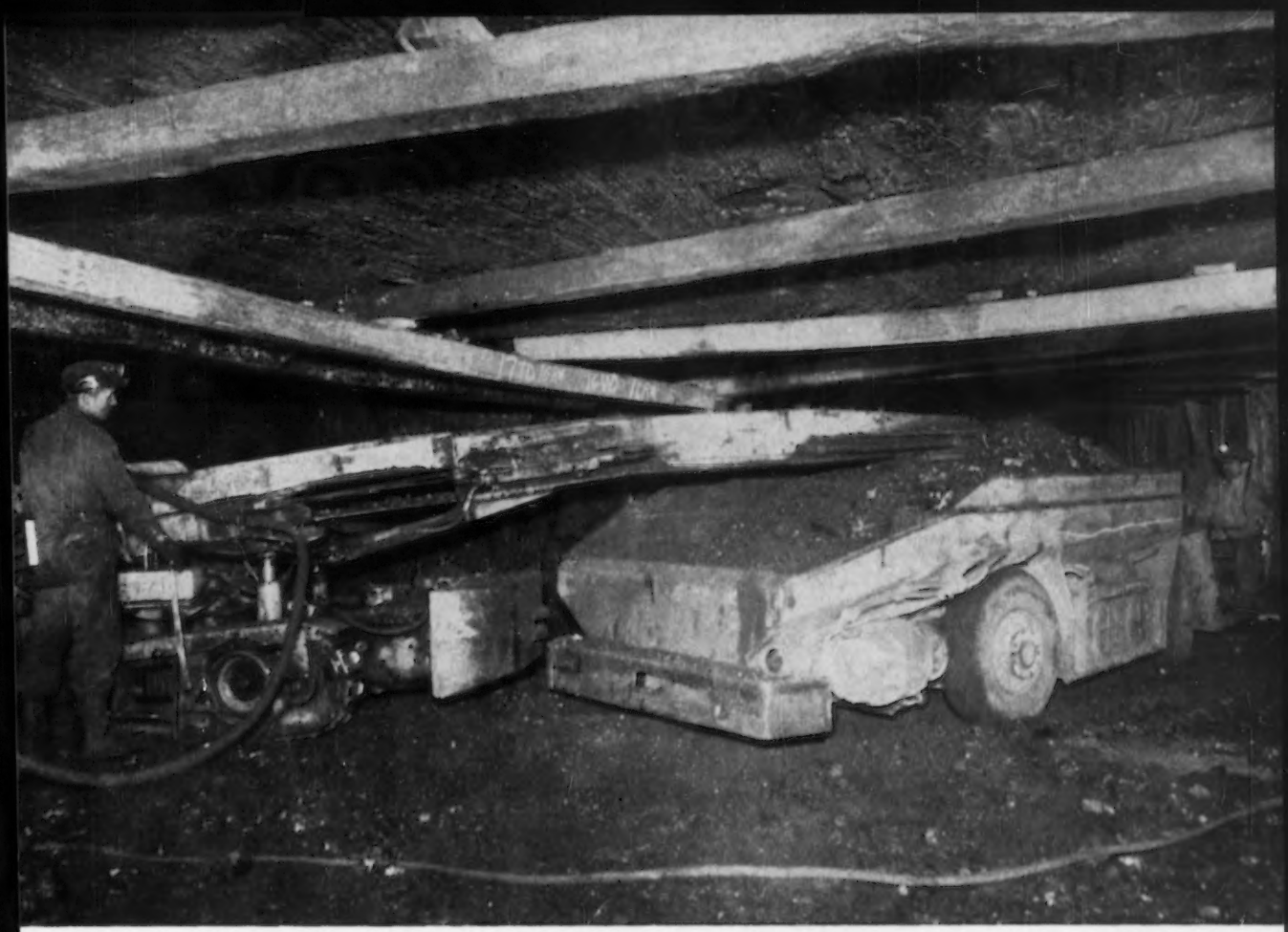
Bristol Silver Mines Co. has discovered extension of its lead-silver-zinc orebody at its Pioche District property on the 700-ft level, according to officials.

The orebody is currently being mined on the 500-ft level.

J. H. Buehler, consultant and former general manager of the company, said the ore deposit was found in the Badger (dolomitic) formation and apparently extends up to the 500-ft level. Grade is "as good or better" than present reserves on the 500, he said. Development work on the 700 will start shortly.

In a move expected to be repeated in other departments, Nevada Mines Division of Kennecott Copper Corp. has consolidated three departments into one—a change permitting a reduction in force of 45. The action was thought to stem from falling copper prices, which forced cutbacks in several copper firms. The departments affected are electrical, mechanical and construction, which became the maintenance department. The division will continue its seven-day schedules.

Sale has been made of seven barite claims on Dry Creek 50 miles north of Wells, to American Colloid Co., Chicago, Ill., which had the properties under option since last summer.



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Conditions in individual mines vary. But you can be sure that you have a shuttle car cable that will resist all of these difficulties if yours is Okocord Red Saddle shuttle car cable (with Hex-Tite construction, of course).

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THE ORE & CHEMICAL CORP.
DIVISION: MINING & MILLING MACHINERY

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Nevada *(Continued)*

Three other claims are under prospect by Mr. and Mrs. Herbert Miller, Dry Creek Ranch, and Mr. and Mrs. Martin Saunders, Elko, who made the deal with American Colloid.

They quoted officials of the midwest firm as being interested in the barite minerals for several uses, including shielding for nuclear reactors.

Flintkote Co., which in 1956 purchased U. S. Lime Products Corp. in Clark County, is producing high calcium limestone from its Apex plant at Arrolime, 19 miles northeast of Las Vegas, and is also producing dolomite quarried at Sloan 19 miles southwest of Las Vegas. The Sloan deposit is said to be one of the largest bodies of high grade dolomite limestone in the U. S. Calcining plant at Sloan has rotary kilns and hydrating equipment; and the one at Henderson has four rotary kilns, large bulk storage, pulverizing units, and pressure hydrating plant.

R. G. Johnson, of Babbitt, president of the Hontune Mining Co., has announced plans to build a 100-ton mill in the near future at the site of the firm's mine southwest of Marietta in Mineral County. Property has a copper vein reported to be 40 ft wide and more than 600 ft long. A road has been constructed to the site, and a 30-ft face cut 10 ft deep has been completed on the vein. The lowest assay taken on the project was a reported 4.6% copper. Two tunnels on the property cut through other copper ore showings.

Dr. John Lechner, secretary of the gold subcommittee of the Western Governors' Minerals Policies Conference, spoke to both houses of the Nevada legislature to urge passage and support of the Beam plan. The latter advocates legislation to permit gold producers to turn their product into gold coins stamped with the gold content. Purpose of the plan is to stimulate gold production and allow a free market. A resolution was introduced by Charles Mendel, Mineral County assemblyman, asking Congress to adopt the plan.

A. D. Drumm, of Fallon, who recently took a lease with option to buy on the Van Ness quicksilver mine, has announced plans to move heavy equipment onto the site as soon as weather permits. Extensive development work will be carried out under direction of Keith N. Meador, consulting geologist, of Reno. The property is situated in the Barcelona district of Nye County 51 miles north of Tonopah. Drumm, who is head of Silver State Construction Co., of Fallon, acquired the lease from John Connolly and Mrs. Homer Williams.

NEW MEXICO

Atlas Corp. has acquired a controlling interest in Rio De Oro Uranium Mines, Inc., of Albuquerque, Floyd B. Odlum, Atlas president, has announced.

Rio De Oro has two substantial orebodies in the Ambrosia Lake area north

Now! A ten-ton wheel loader with ONE-LEVER control of all speeds – forward and reverse

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New Mexico *(Continued)*

of Grants, and the only mine to date in that area producing ore in commercial grades and quantities. The Ambrosia Lake district has been described by the AEC as having one of the largest uranium ore reserves in the U. S. Rio De Oro has to date mined and sold approximately 20,000 tons of ore.

The purchase is being made through Atlas' uranium subsidiary, the 100% owned Hidden Splendor Mining Co., which will operate the mining properties acquired. Hidden Splendor is acquiring in excess of 40% of the outstanding stock of Rio De Oro as well as acquiring certain underlying interests in one of the Rio De Oro orebodies. The Rio De Oro stock is being acquired at a price which, after adjustments, will be between 45 and 50c per share. . Rio De Oro has approximately 1600 other shareholders.

In addition to its mining properties, Rio De Oro is participating with Homestake Mining Co. in the construction of a 750-ton uranium mill near Grants.

New uranium discovery has been made in McKinley County's Ambrosia Lake area by United Western Minerals Co. of Santa Fe, and Four Corners Exploration Co., of Grants.

Orebody was discovered by a 10,000-ft exploratory drilling program conducted by Four Corners under a previously reported farmout agreement with United Western.

Although it has not yet been fully delineated by drilling, the orebody "could be" 100,000 tons or larger. Arrangements have been made for an additional 25,000 ft of drilling to define the deposit.

Ground-breaking ceremonies were scheduled for Mar. 30 for the $5,325,000 uranium mill to be built near grants by Homestake-New Mexico Partners. Contract has been let to Western Knapp Engineering Co. and completion is scheduled by Dec. 1.

U. S. Senators Dennis Chavez and Clinton Anderson, and Gov. Edwin Mechem were among officials invited to take part in the ground-breaking program.

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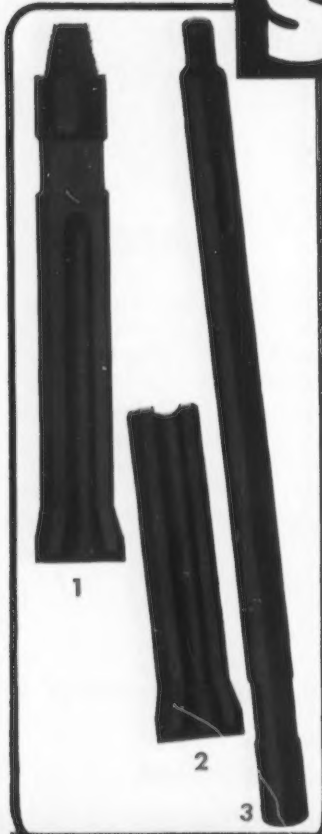
Your inquiries are welcome— contact your nearest Spang dealer or write direct to:



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NEW YORK

Stauffer Chemical Co. will expand its Niagara Falls facilities for the manufacture of both ziconium tetrachloride and silicon tetrachloride. Productive capacity for zirconium tetrachloride will be increased by 40%; capacity for silicon tetrachloride by 20%.

Initial work on both projects has already begun. The company is doing its own engineering and construction, and expects that the new units will be operating within three months.

The plant expansion has been made necessary by the greater demand which now obtains for both chlorides, Stauffer said. The need for zirconium metal, used extensively in nuclear reactors, has contributed substantially to requirements for zirconium tetrachloride, the raw material from which the metal is made.

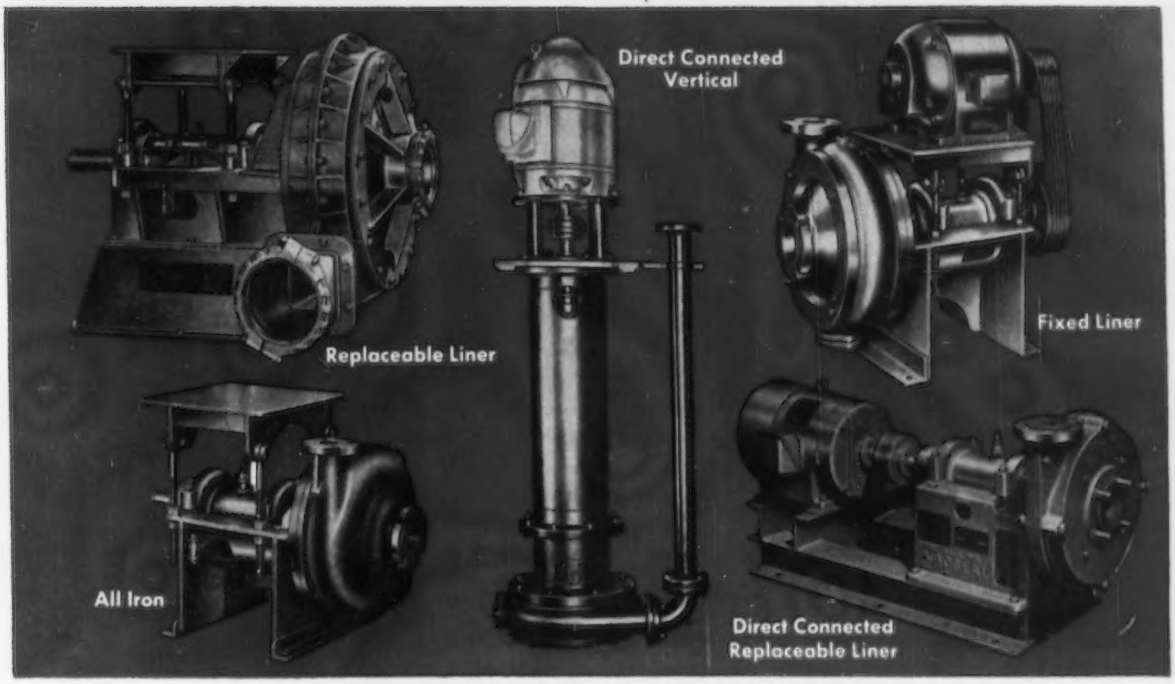
NORTH CAROLINA

Appalachian Sulphides, Inc., a subsidiary of Nippissing Mines Co., Ltd., of Toronto, Canada, expected to put the historic Ore Knob copper mine, 11 miles east of Jefferson, back into operation around mid-March. The mine has been worked on and off since about 1855, but not since 1927 and the operations set up by Appalachian Sulphides will be on a much larger scale than anything ever carried out before.

Philip Eckman, a native of Toronto, is manager of the company, and the present site of the principal operation is slightly less than three quarters of a mile from the old mine, but is part of the same vein. Eckman supervised the survey which established this fact and which revealed reserves of about 1.3-million tons.

Eckman says the company hopes to find more on the present site and at a second site 35 miles to the southeast, where exploratory drilling now is under way.

Nippissing became interested and sent Eckman and the survey party to Ore Knob in 1953 after the U. S. Bureau of Mines, hunting for deposits of strategic metals, surveyed the area in December 1942 during World War II. The Mines Bureau Survey narrowly missed a vein extension, which was discovered by Eckman and his party and the company, as



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ALL IRON OR ALLOY — For such applications as dredging, coarse sand, gravel, lime slurry and corrosive solutions requiring alloys.

VERTICAL — Special mountings for dry-pit and wet-pit service.

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2" x 2½"	50 — 190 gpm
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4" x 6"	300 — 700 gpm
6" x 8"	500 — 1500 gpm
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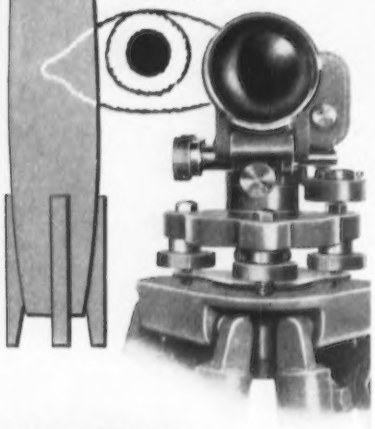

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NEW FURNACES and auxiliary equipment, docks, are due for Sorel.

Quebec Iron & Titanium Plans Expansion

"INCREASED DEMAND FOR SLAG for processing into titanium dioxide pigment. . . . and in the making of titanium metal" has prompted a 60% advance in production at Quebec Iron & Titanium Corp.'s Sorel plant, according to W. L. Walsh, president.

The firm's $16-million expansion plans call for three new furnaces and auxiliary equipment at the Quebec facility, with completion date set for early 1959. Plant service facilities will also be expanded, as will dock and loading facilities at Havre St. Pierre, on the St. Lawrence, where ore is loaded for shipping to Sorel.

North Carolina *(Continued)*

a result brought about 1500 acres of mineral rights and 525 acres of surface rights from Robert Gilliam Lassiter of Oxford.

The company has invested about $2.5-million in its new operation, and the ore will be removed from a vein which ranges from 4 to 56 ft in thickness. At the new plant, the main shaft has been dug vertically to the ore at a depth of 1,040 ft and will go deeper. Along this vertical shaft the company will run horizontal tunnels at different levels to other parts of the orebody.

Concentrate will be shipped to a smelter in Long Island, N. Y.

Associated with Eckman in operation of the mine will be A. A. Dundas, a native of Shumacher, Ontario, who is mine superintendent; George F. Barkhouse, mill superintendent; Sewell Millett, engineer; Dewey Kirstein, field geologist; E. L. Tomney, accountant; W. A. Stoughton, assayer; C. L. Crouse, master mechanic; Noah J. Myers, electrical superintendent; and L. V. Sheets, construction foreman.

When the mining operations get under way the company will process about 350 tpd ore, according to Eckman. A twin processing system with the same capacity also will be installed, and the plant is expected to be processing 700 tpd about four months after initial production starts. By that time it expects to be employing some 130 persons.

The site of the old workings is at a point where the deposit runs fairly close to the surface, but from there the ore ranges downward toward the site of the new plant.

The greatest production period at Ore Knob was from 1873 to 1883. Other operations were carried out in 1896 and a year or so thereafter. The mine was worked again in 1913, in 1917-18 and in 1927.

UTAH

Field samples of uranium ore containing less than 0.05% U_3O_8 have been upgraded to produce concentrates containing nine times the U_3O_8 content of the original ore, Mounain Mesa Uranium Corp. of Casper, Wyo., has announced.

H. O. English, Mountain Mesa president, said the 3-day demonstration runs were confirmed by Ralph Thurston, independent consulting geologist from Lander, Wyo.

Thurston said the process would have a dramatic effect on the entire uranium industry, with special emphasis on the Big Indian Wash area of Utah. Ores of less than 1% U_3O_8, previously unacceptable under the established Government purchase program, have taken on commercial significance.

Huge deposits of low grade ores discarded or by-passed in the original search for ore will have to be re-evaluated in the light of the new upgrading process, he said.

The process reportedly was developed by Tripp Research of Dallas, Tex.

English said the pilot tests were conducted in specially designed equipment capable of treating 1,000 lb an hour. The equipment is a prototype of that planned for a commercial plant. Ore for the tests was trucked to Dallas from the Big Indian Wash area of southeastern Utah, site of early ore finds.

English said plans are under way for construction of a $1-million upgrading plant to be built on Mountain Mesa's Cal Uranium property in Utah. The contemplated 1,000-tpd plant would treat ores from the Cal body as well as other producers in the area.

NOW... DRILL 9" HOLES WITH THE NEW

JOY HEAVYWEIGHT CHAMPION

This world-famous pioneer rotary-air-blast-drill has adopted many of the features of its big brother, the Super-Heavyweight, to give you these advantages:

MORE STABLE DRILL STRING through use of round pipe . . . BETTER AIR CIRCULATION and cuttings removal . . . FASTER DRILLING—faster retraction of hydraulic feed averages total of only 3 minutes on a 51′ hole . . . EXTENDED 55′ MAST permits drilling 50′ hole without adding pipe . . . BETTER MOBILITY —hydraulically raised and lowered mast is left assembled during long moves . . . 9″ HOLE allows wider hole spacing, economical use of large diameter powder.

This all adds up to new records in low cost per ton of rock. Get the whole story on the 58-BHR. Write to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.

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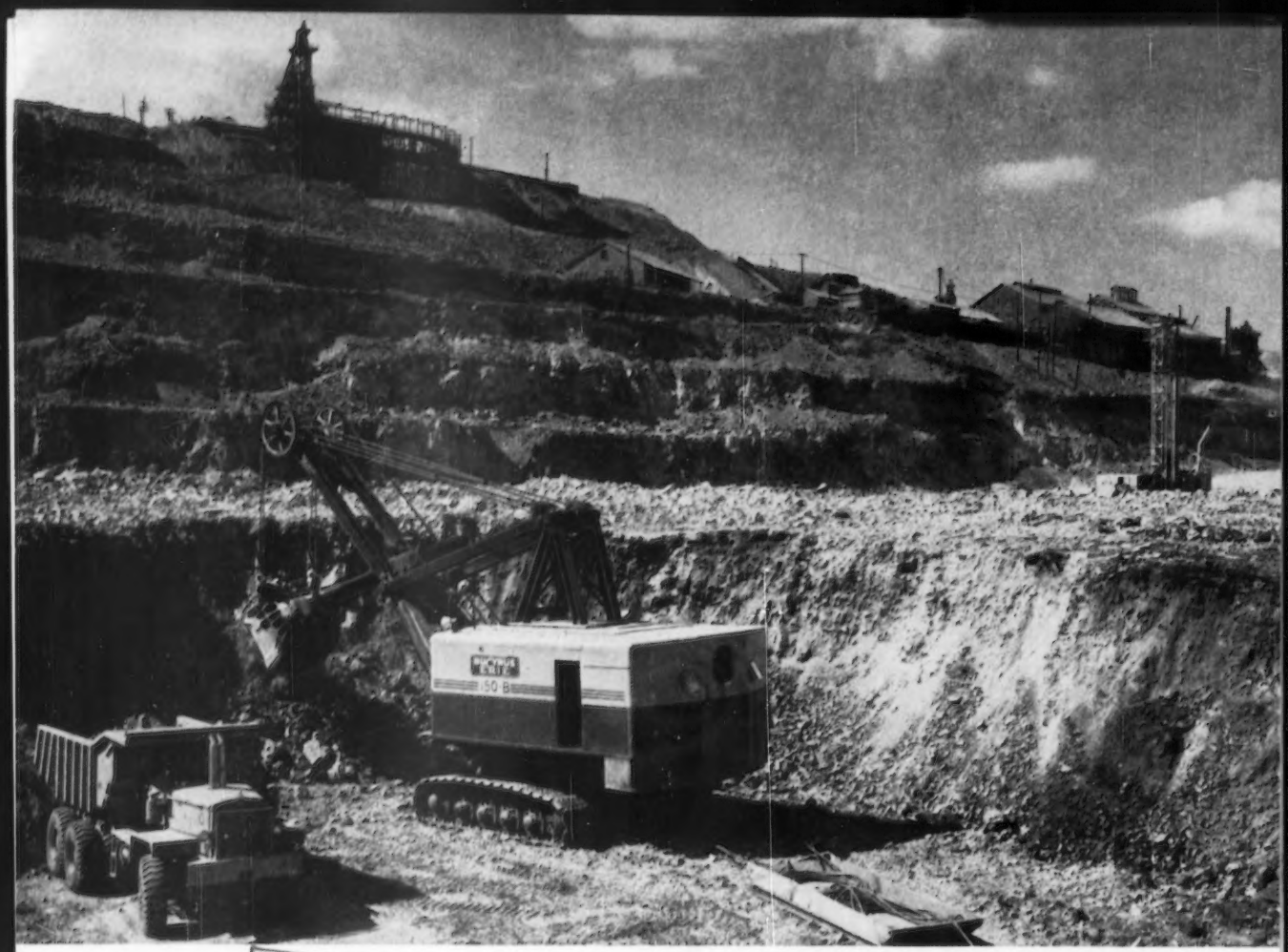

This 150-B is one of several Bucyrus-Erie electric shovels working at a large open pit copper mine in Montana.

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SOUTH MILWAUKEE, WISCONSIN

Utah *(Continued)*

English said the new process will increase Cal Uranium's commercial reserves 2 or 3 times. He said the process will be used as an adjunct to present uranium milling facilities.

The Tripp process differs radically from previous attempts to beneficiate these ores, English said. High recovery is achieved through conversion of the uraniferous minerals occurring in the host rock to a new synthetic uranium compound. A distinct physical property of this synthetic compound allows it to be readily separated from the gangue with less than 5% loss. He said the grade of the final concentrate can be predetermined and controlled to make the best economic use of a particular ore deposit.

Moki Mining Co. reported that 5,542 tons of ore averaging 0.45% U_3O_8 was shipped between Aug. 1 and Dec. 31 from the Moki Mine on Indian Creek.

Mine is on a Utah state lease, and royalties to the state land board for the period totaled $24,175. Gross value of ore shipped, not including development or haulage allowances, was $200,236.

The Moki mine has been operated since last spring by the Rimledge Uranium & Mining Corp.

Utah Legislature is protesting withdrawal of 73,600 acres of land north of Aneth Field in San Juan County by the U. S. Department of Interior for benefit of the Navajo Indian Tribe.

These acres would compensate the Indians for parcels of their reservation (largely uninhabited) which would be inundated in a couple of years by the lake created by Glen Canyon dam—east side of which is on tribal holdings.

A concurrent resolution certain to be passed by Utah Senate and House calls attention to the fact that Congress in 1913 specifically stated that there would be no further withdrawal of public domain for additions to the Navajo reservation following creation of the "Aneth Extension."

This extension, north of the San Juan River, contains Aneth, East Aneth and several oil pools.

WASHINGTON

Howe Sound Co. will close the Holden mine in Chelan County because rising mining costs and lower copper prices have made the operation "unprofitable."

It is one of two mines the company plans to close. The other is the Snow Lake gold mine in Manitoba, Canada.

The Holden mine has been Washington State's leading copper producer in recent years. It was transferred to Howe Sound in 1929 and once employed more than 300.

The company said the cost of extracting copper, gold and zinc ores at the mine has risen to a point "where continued operation has become unprofitable."

It was estimated that it would take up to two years to close down the mine completely.

Grandview Mines, Spokane, will receive a minimum income of $416,925 during

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Utah *(Continued)*

the next six years under terms of a purchase agreement covering the Grandview mine near Metaline Falls, signed with American Zinc, Lead & Smelting Co.

Karl W. Jasper, company president, said Grandview will receive $250,000 for its interest in machinery, equipment, mine buildings and other personal property at the Grandview mine.

A $150,000 cash down payment was made last week and the remaining $100,000 will be paid at the rate of $10,000 a quarter starting in July.

For estimated ore reserves remaining in the mine, Grandview will get $146,925. This will be disbursed on a royalty basis with a minimum annual guarantee of $25,000.

When these payments are completed, Grandview will give American Zinc a deed in exchange for an additional cash payment of $20,000 to cover remaining mineral rights.

Officials said Grandview would continue to receive royalties on all ore taken out of the Grandview property in addition to the presently estimated reserves.

Jasper said that during the last three years Grandview has not made any money from a profit-sharing agreement with American Zinc, which was amended from a royalty leasing agreement in 1950.

Jasper told a stockholders meeting Feb. 18 that his firm is making a capital gain of $250,000 under the agreement.

Meanwhile, a motion has been filed in district court at Spokane stipulating that a $416,000 suit filed against American Zinc by Grandview can be dismissed.

Daybreak Uranium, Inc., announced award of a contract to Addy Development Co. for sinking an inclined shaft at Daybreak's mine at the Lowley lease on the Spokane Indian reservation.

Kae H. Sowers, Daybreak secretary-treasurer, said the work would extend down about 50 ft plus tunneling 175 ft into a mineralized zone exposed previously by bulldozing on the surface.

He said the firm plans to stockpile ore at the lease for shipment to the new uranium mill now under construction at Ford for Dawn Mining Co., a subsidiary of Newmont Mining Corp. The mill is to be completed in July.

Meanwhile, Daybreak has shipped about five cars of the ore from the lease to Vitro Uranium Co. at Salt Lake City.

WYOMING

Lucky Mc Uranium Corp. started a major stripping operation in the Gas Hills area April 1. More than 1.5-million cu yd of dirt will be moved to uncover a blocked-out orebody, but actual mining is not expected to start until 1958, when Lucky Mc's $7-million uranium mill is completed.

Overburden on the two orebodies to be uncovered will be removed with tractors and carry-all scrapers. The pit will feature benches to make it a safe operation. Pumps will be utilized to remove a large volume of water.

About 40 ft of overburden will have

Wyoming *(Continued)*

to be removed from the main orebody on which Lucky Mc's present pits are located. Between 70 and 80 ft of overburden will be removed on the "Project 4" area located south of the firm's main orebody and between Vitro and Lost Creek properties. The pit on Project 4 will be about 700 ft wide and 1200 ft long.

Cheechako Development Corp. has commenced gypsum mining operations at the Circle Ridge area 27 miles northwest of Riverton, Wyo. on the Wind River Indian Reservation.

W. D. Franklin, Boston, Mass., has filed more than 200 uranium claims in the Big Horn River-Pryor Mt. area in northeast portion of Big Horn County.

The area, in which several mines are now operating, has seen active prospecting during final half of 1956 by a number of Western mining firms.

Recording of mining claims in the county clerk's office will give the discoverer adequate protection, the Wyoming Supreme Court ruled in a controversial case involving the Pumpkin Buttes mining district.

The Campbell County district court had originally ordered the mining district to record claims of a prospector who refused to adhere to all regulations of the district.

Justice Harry Harnsberger, in the opinion, said there was no need for filing of any claims with a mining district as long as they are filed with the county clerk.

Two more uranium companies have announced they are negotiating with the AEC to locate uranium processing mills in the Gas Hills.

Globe Mining Co., one of the Gas Hills' leading producers, said it has been discussing plans for a mill with AEC officials for more than two months and is now about ready to submit a firm proposal for a mill.

The proposed Globe mill would be a combination mill to handle ores from its own property with a certain portion allotted to other independent producers under custom mill allocations.

It is estimated Globe has reserves of from 400,000 to 550,000 tons of ore from its west Gas Hills properties.

Giant Resources, Inc., of Grand Junction, Colo., also has announced it has begun preliminary discussions with the AEC for a uranium mill in the Gas Hills area.

The Colorado School of Mines Research Foundation is conducting reserve studies, amenability tests and metallurgical tests for a proposed mill.

Bengal Uranium Co. has begun shipments from its deep pit in the Gas Hills area of Fremont County.

Bengal spent all winter stripping the pit. The gigantic dog-leg shaped pit is 235 ft long and 130 ft wide. Ore is at a depth of 80 ft.

Initial shipments were made to the AEC buying station at the site of the Lost Creek mill near Split Rock, about 30 miles from the pit. Joseph S. Mabey, field manager, and Joseph S. Merrill,

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Wyoming *(Continued)*

field geologist, have been conducting operations for Bengal, a Salt Lake City firm.

Shamrock Uranium of Orem, Utah, has acquired an interest in the Redwood mine of Two States Uranium Corp. and the Valley Dean Co. of the East Gas Hills area.

Mine is the largest and deepest open pit mine in the Gas Hills area. The orebody was the second of 14 discovered by Einar C. Erickson, Provo, Utah, geologist, who is president of Shamrock.

Erickson has engineered an open pit 140 ft deep, exposing a 32-ft thick orebody. Shamrock secretary Harry Russell said more than 400,000 cu yd of overburden were removed to mine nearly 25,000 tons of ore. Another 1,800,000 cu yd of overburden will be removed to recover another 20,000 tons of ore blocked out.

Since March 1956, more than 1,500 tons of ore per month have been shipped from the mine, and present contracts call for shipment of 40,000 tons a year.

IN CANADA

ONTARIO

Coldstream Copper Mines has added to ore estimates at its Shebandowan area copper property, 70 miles west of the Lakehead. Total ore outlined is now estimated at 2,648,000 tons grading 2.2% copper to the 6 or 800-ft level. This tonnage includes 480,000 tons averaging 2.98% between the 3 and 4 levels and 460,000 tons averaging 3.26% between the 4 and 5 levels. Company expects to get its new 1,000-tpd mill into operation by late May or early June.

Diamond drilling at the El Sol Gold Mines' iron prospect, 65 miles north of Sioux Lookout, is adding substantially to indicated tonnage. Latest calculations show 106.8-million tons of magnetite averaging 31% iron in the combined "A" and "B" zones. All holes drilled have been above 500-ft depth and only about 20% of the "B" zone has been explored. Drilling on both zones is being continued with one deep hole being put down to 1,000 ft. Metallurgical tests are also being carried out.

Caland Ore Co. has awarded a contract for the sinking of an 8-compartment shaft at its large iron property at Steep Rock. The shaft to be sunk to an initial depth of 1300 ft is designed to permit hoisting of 1.5-million tons of ore yearly as well as handling men and supplies for the underground operation. First production, which will be by open pit, is scheduled for 1960. Dredging operations to remove silt overlying the orebody is continuing.

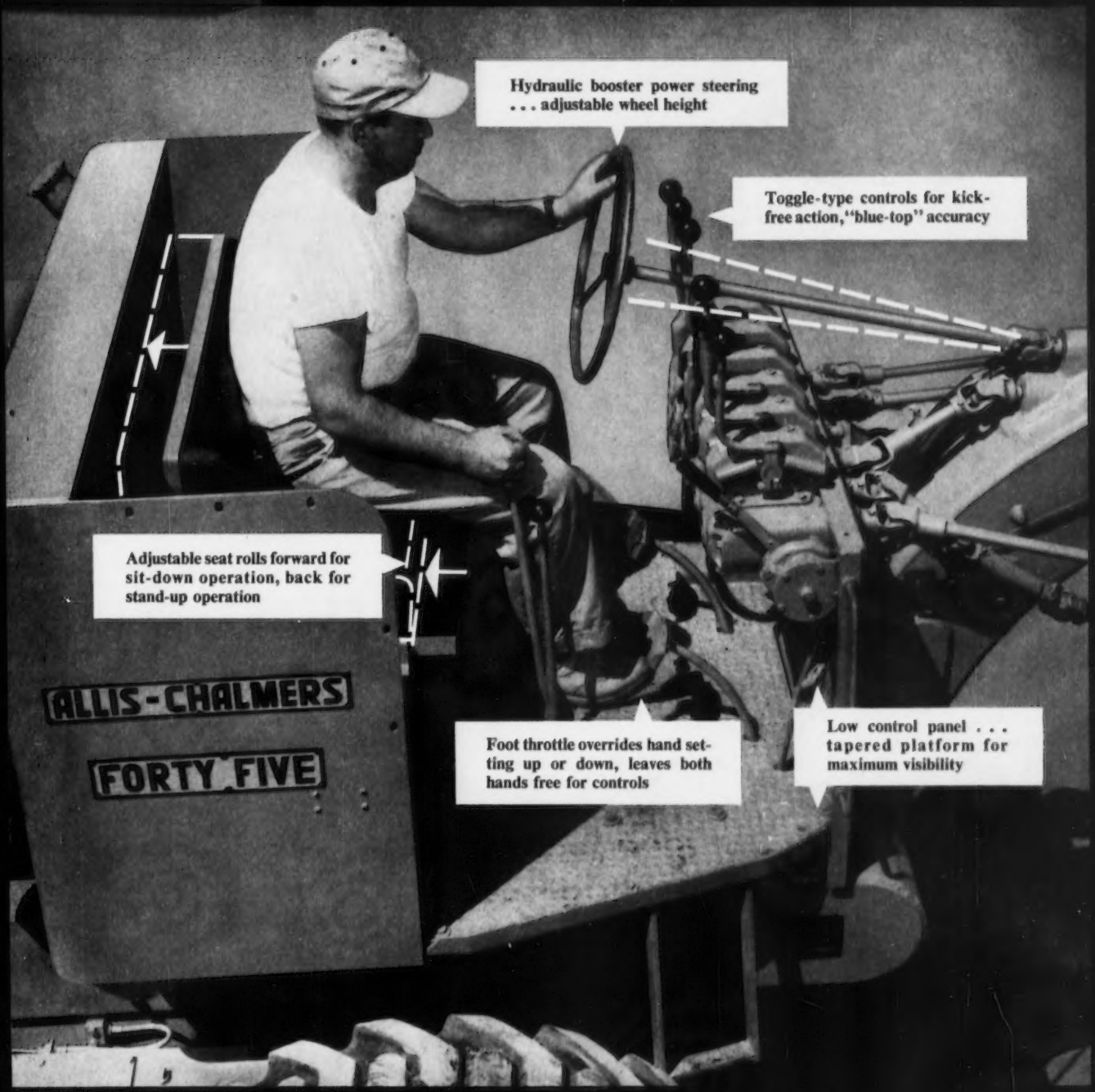
New Dickenson Mines is arranging to push a 2,000-ft exploration drive out on its 15 or 2165-ft level into the adjoining property of Robin Red Lake Mines. Noranda (25%) and Dome Mines (25%) are participating in the program which calls for minimum expenditure of $50,000 after the drive reaches the Robin boundary. Exploratory drilling will follow completion of the drive. The properties are located in the Red Lake area.

Stanrock Uranium Mines is making speedy progress in mine development and plant construction at its Blind River uranium property. Two shafts, one for production and the other for service, are now being put down. The production opening is expected to intersect the ore horizon at 3125 ft and the service shaft at about 2700 ft. Initial production is scheduled to start at a rate of around 1,000 tpd in November. This rate will be gradually increased to 3,000 tpd. Company has a $94-million contract with Eldorado Mining & Refining Ltd. Indicated ore reserves are estimated at 7,509,148 tons grading 0.106% uranium oxide.

Final figures for 1956 ore shipments from Steep Rock Iron Mines, Ltd., are 3,317,073, about four times the 830,409 tons shipped 10 years earlier in 1946. The 1956 tonnage came from the Hogarth pit, 3,091,828 tons and the rapidly developing Errington underground mine, 225,245 tons. The schedule for 1957 calls for 2,750,000 tons from the Hogarth pit and 750,000 tons from the Errington underground.

The dredging of Steep Rock's "G" orebody is nearly one-half completed.

Ontario *(Continued)*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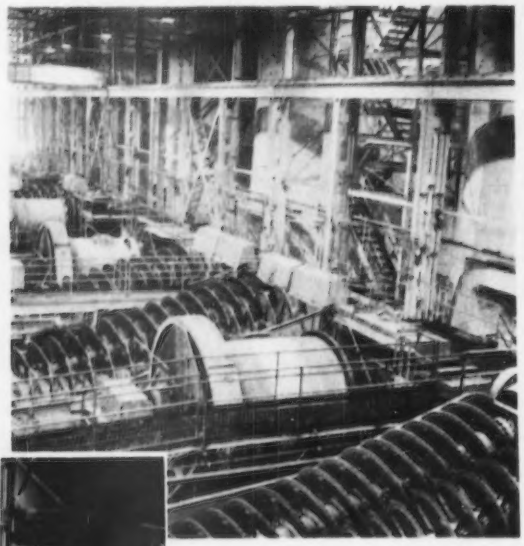

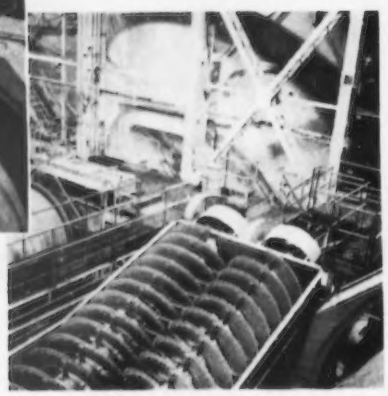

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Ontario *(Continued)*

Caland Ore Co., Ltd. (Inland Steel Co.), with two large electric dredges in operation, has moved about 60-million cu yd of the 170-million silt originally estimated to cover its Falls Bay property, known as "C" orebody, leased from Steep Rock. Dredging began in the spring of 1955 and is now ahead of schedule. If the present rate is continued, dredging should be completed early in 1960.

QUEBEC

Beattie-Duquesne Mines is shipping at a rate of 400 tpd from its Hunter copper property in Duparquet Twp. Milling commenced at the beginning of this year. Mill recovery for the first month of production was about 96% with heads averaging 1.3% copper. Grade is expected to be increased as stoping operations expand. Development work is in progress on all four levels at 150-, 300-, 450-, and 600-ft horizons.

Copper Rand Chibougamau Mines is concentrating efforts on the underground development of the Eaton Bay zone at its Chibougamau area copper property. The drive on the zone from the No. 2 shaft is being pushed on three horizons, the 275, 400 and 525. From surface drilling this zone is estimated to contain about 5,000 tons per vertical foot grading 2.6% copper. Plans are to sink a large production shaft closer to the zone but final decision on size and location has not been made yet. Work at the No. 1 and 3 shafts has been suspended for the present.

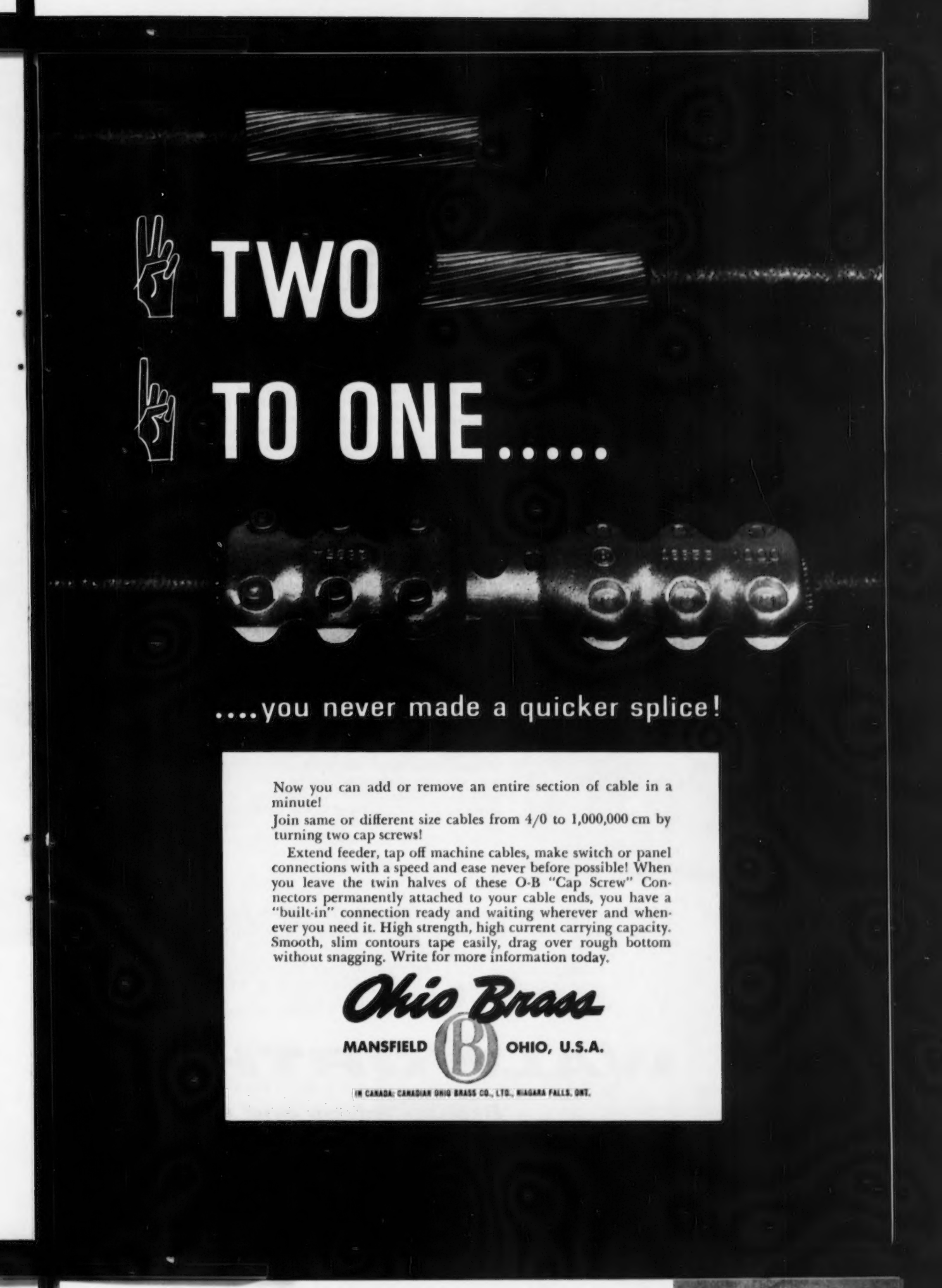
Chibougamau Jaculet Mines has been employing 19 drills to probe ore zones from the ice on Dore Lake in the Chibougamau area. In addition, shaft sinking is in progress to an initial depth of 700 ft. Following completion of the shaft 15 headings, or five on each of the three levels to be established, will be opened. It is expected that by the end of July or early August underground work will have progressed sufficiently to provide a fairly good picture of the ore zones and permit further planning.

Southern Asbestos Co. Ltd. has decided to proceed immediately with underground exploration indicated by a report of its engineer, the company reports. Adequate funds, it is stated, are available.

The presence of geological conditions favorable to sizable asbestos deposition, the report states, are indicated at the company's holdings, which consist of 300 acres in Templeton Township, about 100 miles west of Buckingham.

Barvallee Mines Ltd. has signed an agreement with National Lead Co. of New York under which the latter will undertake an exploration and development program at Barvallee's base-metal property in Fiedmont.

Barvallee reports that, under the agreement, National Lead will provide all the funds required for a six-month exploration and development program, with an



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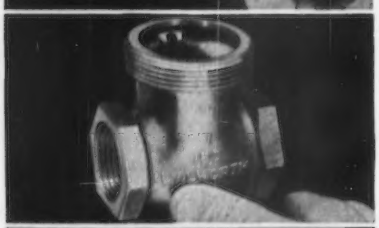

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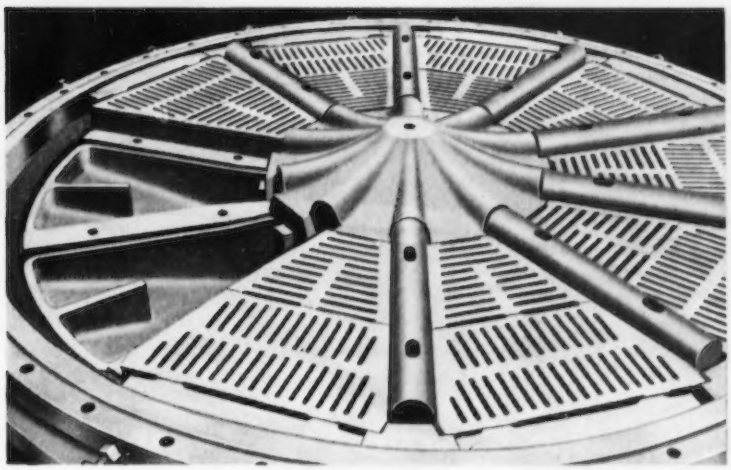

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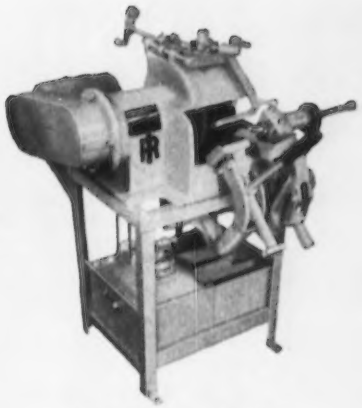

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15-518

Quebec *(Continued)*

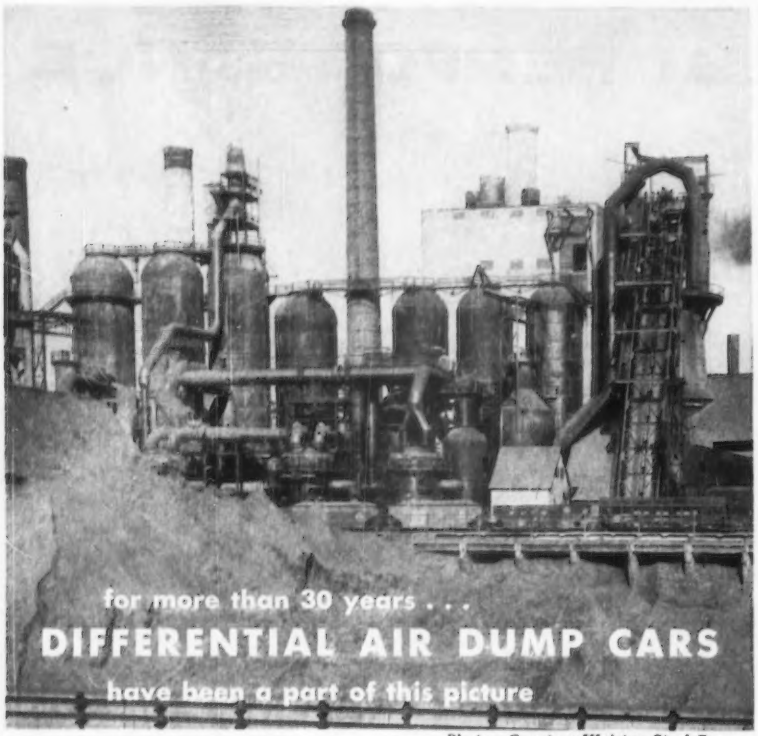
option to extend the program for a further six months.

Merrill Island Mining Corp. will build a 750-ton concentrator at Chibougamou, with production to start at year end. Mill will treat ores from the company's unleased property near Campbell Chibougamou Mines.

MANITOBA

Lee Gordon Mines has optioned its Vamp Lake holdings to Mining Corporation of Canada. Property lies two miles west of Mile 26 on the Lynn Lake railroad. A geophysical survey and diamond drilling program is being carried out at the present time. Previous drilling by Lee Gordon Mines in 1952 indicated some good sections of zinc-copper-gold ore.

New Manitoba Gold Mines reports that shaft sinking at its Cat Lake property is nearing the 350-ft level. The company reports that diamond drilling has indicated 1.8-million tons of nickel-copper ore to a depth of 425 ft. First production is planned at 1,000 tpd. A highway and power line have been completed.



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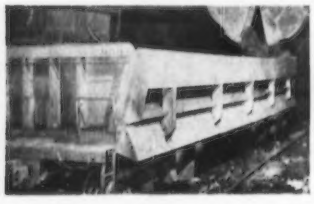

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SINCE 1915 PIONEERS IN HAULAGE EQUIPMENT

Dalhart Minerals has acquired more ground in the Winnipeg River area where the company is investigating a beryl prospect. Plans call for the diamond drilling of the main occurrence where surface exploration indicated good beryl values for a length of 415 ft. It is also planned to set up an assay laboratory on the property.

Parrex Mining Syndicate reports geophysical investigations are being carried out along the line of contact between the Precambrian and Palaeozoic formations west from the Herb Lake area to the Saskatchewan boundary. Diamond drilling is being undertaken in anomalies near Herb Lake and indications are that massive sulphides have been intersected on one of the several anomalies under investigation. Additional ground is being acquired. Parrex is financed by several companies including Noranda Mines, Mining Corp., Teck-Hughes and Lamaque.

Hudson Bay Mining & Smelting has completed a road into its Chisel Lake Property connecting with the highway to Wekusko. The power line hook-up with the Snow Lake transmission line has also been completed. Shaft sinking is planned for on two of the Hudson Bay base metal deposits during the summer.

BRITISH COLUMBIA

B. C. government revealed that the Wenner-Gren Foundation, headed by international financier Dr. Axel Wenner-Gren had advanced a scheme to tap the vast natural resources of a 40,000-sq mile area of the province often referred to as North America's last frontier.

Area lies north of Prince George along the Rocky Mountain Trench and is believed to be a mineral treasure house.

Wenner-Gren, in outlining the deal which could approximate a billion dollars in cost proposed: (1) construction in 1960 of the world's first long-distance monorail freight line to run north through the Trench to the Yukon border, joining up with the Pacific Great Eastern Railway to provide a carrier for ores; (2) a $5-million, two-year survey of the area by Swedish, British and Canadian engineering firms, which now is under way; (3) construction of pulp mills, sawmills, hydroelectric power units, townsites, mining camps, roads and technical schools as part of the plan, profits of which would be used by Wenner-Gren Foundation for advancement of scientific studies.

To facilitate the surveys, the government has granted a mineral reservation on about 15% of the area where no one can prospect or stake claims.

Mining industry opposition, spearheaded by the B. C. and Yukon Chamber of Mines, is aimed at the granting of the mineral reservation to Wenner-Gren on grounds that it "would tie up some of the most promising mineral-bearing area" in the Rocky Mountain Trench.

Woodgreen Copper Mines Ltd. shipped

Part of the equipment used in the excavating operation at Pima Mine, Arizona. Operations will be completed about January, 1957.

STOODY HARD-FACING in one of the WORLD'S LARGEST OVERBURDEN STRIPPING PROJECTS

A huge stripping operation is in progress a few miles south of Tucson, Arizona, at the Pima Mine where Utah Construction Company is moving 6,000,000 cubic yards of overburden, including 600,000 yards of waste rock, to expose the copper ore deposit 210 feet below the surface. The job was begun in October of 1955 and will probably be completed by January of 1957.

An unusual feature of this project is the method of moving the overburden, a highly abrasive alluvial soil. Instead of the usual blast hole equipment, shovels and dump trucks, the job is primarily handled with rippers and scrapers. After the rippers make a pass, scrapers pushed by crawlers pick up the loose material and haul it to a fill. The equipment inventory includes a D9 Cat ripper, an HD21 A-C ripper, 10 MRS scrapers, two Cat 12 motor graders, six A-C and two D9 Cat pushers, four LLD 30-yard trucks, a Marion 7-yard shovel, a Michigan dozer and two water wagons.

One out of three shifts is devoted to maintenance and repairs. Hard-facing of many pieces of equipment is speeded up by the use of the semi-automatic welder applying Stoody 100. On ripper and bucket teeth which are subject to severest wear, Stoody Tube Borium is applied manually as a final overlay.

Hard-facing methods used here are described in the Stoody Guidebook and the folder on semi-automatic wires. See your Stoody dealer for a copy of this literature (check the yellow pages of your phone book) or write direct.

RIPPER TEETH—are hard-faced with two close, parallel beads of Stoody 100 across the point with an open-bead cross pattern up the tooth face. Points also receive a bead of Tube Borium on the under sides.

SHOVELS AND TEETH—at noon and at the end of the second shift tooth points are touched up with Tube Borium. Three stringer beads on the tooth are equivalent to a full inch of bare tooth wear. With this treatment teeth usually last six to eight shifts. Repointer bars are welded on worn teeth, hard-faced semi-automatically with Stoody 100 and finished off with Tube Borium.

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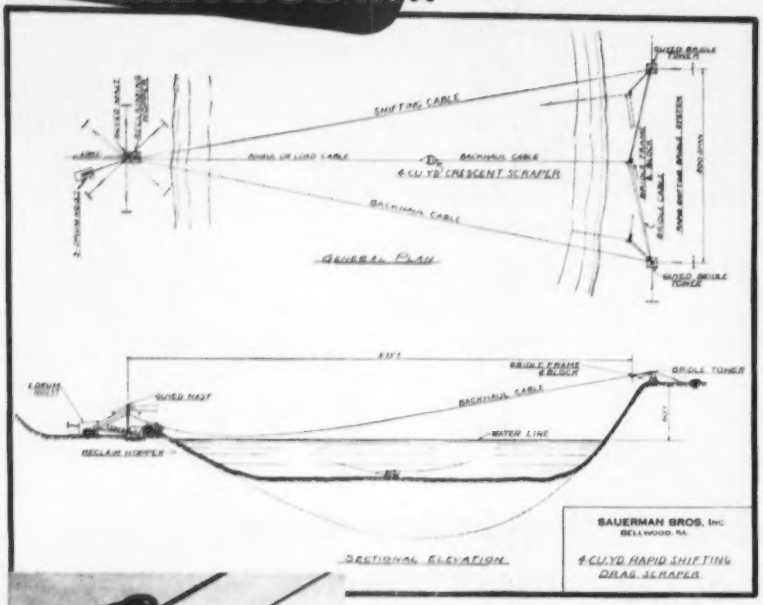

Above drawing was prepared for a specific drag scraper installation and does not represent maximum spans.

View shows rapid shifting bridle frame and all operating cables. Crescent may be seen in background conveying load to reclaiming hopper just in front of mast.

•

Contact Sauerman's engineering department for specific recommendations and information. No obligation.

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Every scraper machine is powered by a Sauerman Roller Bearing Hoist, especially designed to withstand sudden shocks and changes in speed.

When a rapid shifter is used, a third hoist drum is added to shift the bridle frame. The rapid-shifting bridle system (upper right of drawing) permits frequent shifting of the scraper's line of operation in non-caving material, shallow excavations or overburden.

Operating costs are lower—basically, it is cheaper to drag material than it is to lift and transport it. You eliminate the power costs of moving heavy machinery about the area. You pay only for pay loads—not dead weight. When expendable parts—sheaves, clutch or brake linings—are replaced, the machine is restored to practically new condition.

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B. C. *(Continued)*

its first load of copper concentrates to the Tacoma smelter. It graded about 19% copper and was the first value recovered from the renowned old Motherlode property since it was closed down 39 years ago.

The newly-opened 1,000-ton mill, now working at half capacity, was expected to be in full production by end of March. Despite the high grade of ore shipped recently, the Woodgreen operation will be based on open-pit mining of low-grade ore, because it is easily accessible near the mill.

Mid-West Copper & Uranium shipped five cars of concentrates to the Tacoma smelter during first month of tuning-up period at the Velvet Mine near Rossland.

The cars reportedly contained 268 oz gold, 258 oz silver and 58,920 lb of copper, and concentrates now have been brought up to "just under two ounces gold per ton and about 23% copper."

An increase in mill production is scheduled.

Granby Consolidated Mining, Smelting & Power Co. Ltd. plans to start production on its Phoenix copper property this summer with a 500-ton mill. Equipment will be moved in from the Copper Mountain mine which is expected to close down shortly.

Northlodge Copper Mines Ltd. and American Smelting & Refining are studying an agreement whereby AS&R will develop the Northlodge property. AS&R will get 70% interest in the property, Northlodge retaining 30%. A preliminary six-month's examination will be made of an anomaly on the property, including drilling and then further examination over a 2½-year period.

Cowichan Copper Co. Ltd., Vancouver Island, is reported to be negotiating with two groups, one in United States and one representing Japanese interests, for establishment of a 1,000-ton mill at Cowichan's property, to begin operation by the end of this year.

It is proposed that the group providing mill funds would buy the mill's full output of concentrates at the market price but would be reimbursed for the outlay from the proceeds of production.

Latest report on the ore picture gives Cowichan about 1.5-million tons indicated, with little further work needed to establish it as proved with an average grade of 3% copper.

ALBERTA

Gold and uranium valued at $400-million will be produced during the next five years in Canada's northern area between Lake Athabasca and the delta of the Mackenzie River, according to a forecast by an official of Eldorado Mining & Refining Ltd.

W. M. Gilchrist, manager of Eldorado, made the prediction in Edmonton at the second annual Northwest Prospectors and Developers Convention un-

B.F.Goodrich

How Eagle-Picher gets 2 to 3 retreads from B.F.Goodrich all-nylon tires

THE EAGLE-PICHER COMPANY mines and processes lead and zinc ore in northeastern Oklahoma. Inside the mine, dump trucks haul 9.5-ton loads, trailers haul 15-ton loads. Diesels used for outside hauling average 15¾ tons per load. Eagle-Picher used B.F.Goodrich *all-nylon* tires for all these jobs.

The B.F.Goodrich Rock Logger tires above and Universal tires (below left) work inside the mine on a bed of slippery flint rock, yet carry over 3,500 tons a month and give 18 months' service before retreading. Traction Express tires (below right) cover up to 4,000 miles a month on gravel roads. In spite of this rugged work, Eagle-Picher gets as many as 3 retreads from B.F.Goodrich tires!

The B.F.Goodrich *all-nylon* cord body is stronger than ordinary cord materials, withstands double the impact and resists heat blowouts and flex breaks. That's why the B.F.Goodrich *all-nylon* cord body outwears even the extra-thick tread, *can be retreaded over and over!* You get more hours of tire service at lower cost per hour.

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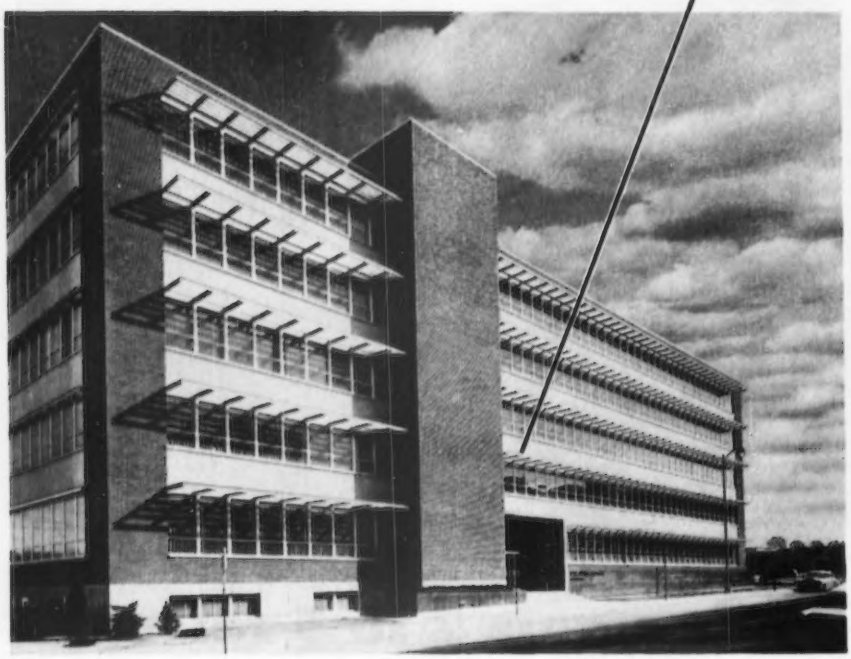

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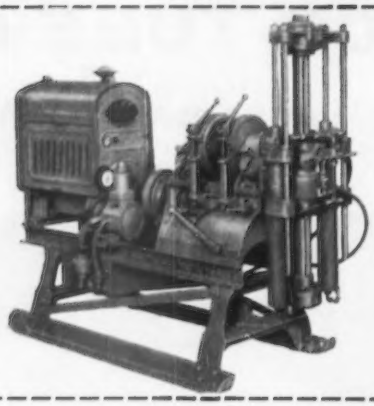

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WIRE ROPE AT WORK

This picture graphically illustrates the tremendous role of the dragline excavator in surface mining. The workhorse you see here, scooping up big bites of overburden, seems to be digging a canyon while at the same time creating a small mountain range. It is owned by J. Robert Bazley Inc., a stripping contractor well known for his work in the coal fields of Eastern Pennsylvania.

Wire rope plays a particularly important part in the operation of a dragline machine. In this case, the owner made sure of long rope life by rigging with Bethlehem lines throughout. Ropes of three sizes were involved: 1⅞-in. diam for the drag, 1⅜ for the hoist, 1¼ for the boom. All were Purple Strand Form-Set, Bethlehem's top-grade preformed; and all had independent wire-rope core to protect against crushing.

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Alberta *(Continued)*

der sponsorship of the Alberta and Northwest Chamber of Mines.

Approximately 300 delegates from far-flung points of the North American continent attended the one-day convention which was highlighted by bright predictions for mineral development in Canada's Northland.

Among speakers, in addition to Gilchrist, were Steve Homulus, mine inspector the Northwest Territories; J. N. Botsford, of Uranium City, manager of Gunnar Mines Ltd; and Robert Webb, biologist for the Alberta government's game branch.

Gilchrist predicted uranium and gold production for the Mackenzie, Athabasca area during the next five years of about $400-million.

In predicting great development for the Northern areas of Canada, he said that chances for future development look good in every department. He mentioned in particular the Pine Point lead-zinc deposits, interest in base metals east and north of Great Bear Lake and in nickel and iron around the east end of Lake Athabasca.

Gilchrist commented that despite the fine outlook for minerals there was some question as to "whether we as Canadians respond to opportunities in the same way as our land responds to development."

He suggested that lack of initiative on the part of Canadians has led to development by Americans of rich resources in Canada's north.

"There does not seem to be any limit as yet to the minerals that could be found," Gilchrist emphasized.

Homulus traced the history of mining development and exploration in the Northwest Territories. He observed that increased demand for copper resulted last year in an intensive search for the mineral and that several properties are being developed near the Arctic Ocean. This work will be carried on for three or four more years, he noted.

Homulus said that only gold, silver and uranium have been mined successfully in the territories to date because of prohibitive costs of transportation.

Increasing demand for base metals, however, will lead mining men to turn to the territories in the future, he predicted.

The development of Gunnar Mines Ltd. uranium deposit was described by Botsford.

Also participating at convention sessions were Charles A. Hames, assistant manager of Sherritt Gordon Mines Ltd., and J. C. Parres, mining geologist, Saskatoon, Sask.

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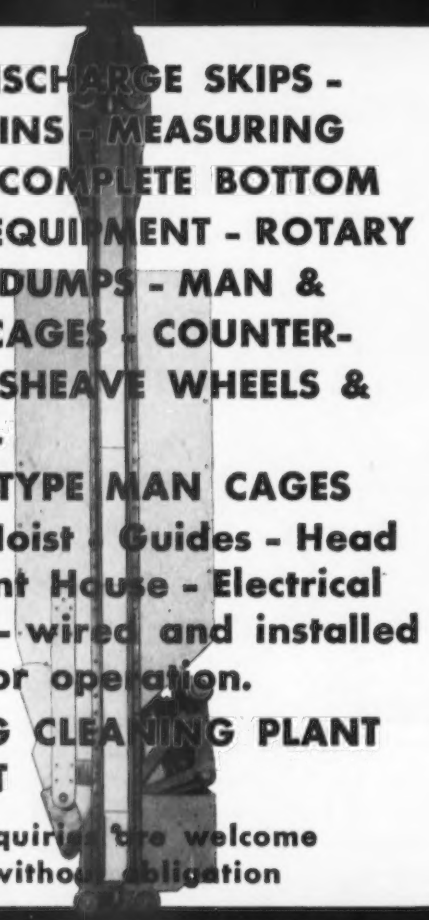

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IN LATIN AMERICA

CHILE

Chile Exploration Copper Co. will reach a record production this year, aiming at an output of 1,000 tons of copper per day. To make sure of this rate of production, the construction of a new 40,000 kw steam turbine-generator unit will be started soon. Expansion of its generating plant will continue until 120,000 additional kw will be added which will make Chuqui's generating plants the largest in the country. According to Richard Newlin, an Anaconda vice president, the molybdenum flotation mill will be on stream by April. **Mining Credit Bank sold last year 26,286 metric tons of electrolytic copper.** Of this total, 22,722 were refined at the Nordeutsche Affinerie in Hamburg and the balance in Tacoma, Wash. This copper was sold at an average price of 41.82c per pound and was thus sold over the average prevailing prices of the London Metal Exchange. Of this total, Germany bought 18,992 metric tons. The total value of these sales amounted to $24,183,136. United States bought 3,564 tons; Spain, 30,000 tons and Brazil, 800.

Mining Credit Bank will not export any more copper ores and concentrates this year or in the future but will smelt these in the Paipote copper smelter. The bank was exporting copper ores and con-

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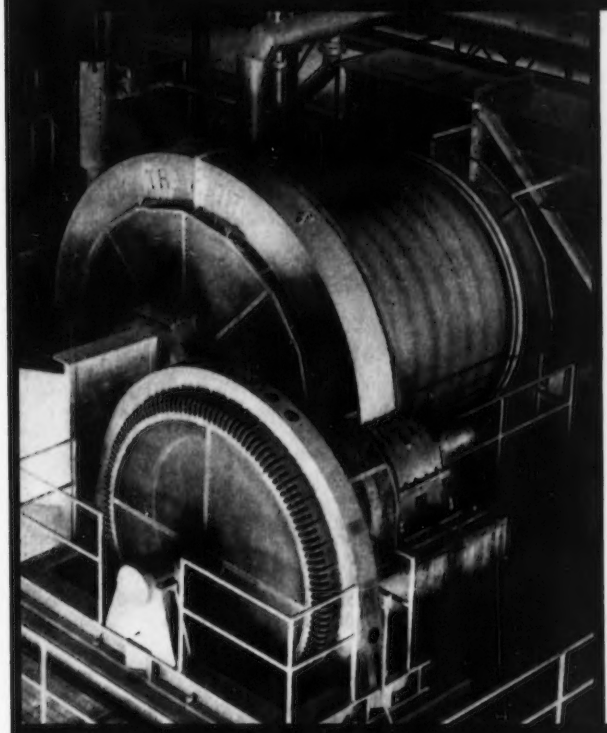

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Chile *(Continued)*

centrates at the rate of 110,000 short tons yearly to Hamburg and Tacoma. Only the blister from Paipote will be exported under the existing contract with the Nordeutsche Affinerie to be there refined. This new policy is due to the fact that ocean freight has been raised by $2 per ton and smelting charge, one dollar per ton. The smelting of all ores and concentrates at Paipote will represent a saving to the bank of $3-million per year.

Executive vice president of the Copper Department has declared that Chile has already sold in advance the copper output from the three American companies operating in Chile which is estimated will be 550,000 short tons of copper.

Mining Credit Bank will not receive more copper concentrates in its agencies of Choapa, Illapel, Combarbalá, Punitaqui, Ovalle y Los Vilos. Producers from the southern zone can deliver their concentrates to the Agencies of Tiltil or Paipote but from the price of the concentrate the freight to Coquimbo will be deducted whether deliveries be made at Tiltil (near Santiago), or at the Paipote Smelter directly.

Three geologists from Cerro de Pasco Corp. have arrived at Niriguao near Cayhaique, Aisén Province, to examine the mining possibilities of this zone, especially with regard to the lead and zinc deposits which are said to be abundant in this region. Cia. Minera Aisén, a Chilean mining enterprise, has for years been mining, milling and smelting lead ores in Aisén Province near the Buenos Aires Lake. Cia. Minera Peñarroya, a well known French enterprise with lead mines in Spain and Africa, has also been prospecting for years in Aisén.

MEXICO

Initial production was expected last month from the new 60-tpd mill of Inter-American Development Corp. at Sabinas Hidalgo. Stuart Land, Houston president of the firm, said the mill will treat lead, zinc and silver ore from the Dona Marina and Guadalupe mines which had been previously been thrown on the dump. Plant will be operated by Fomento Inter-Americana, wholly-owned subsidiary of Inter-American, and Cia. Minera Timco, a Mexican firm.

Impulsora Minera de Angangueo, new operating company at the Angangueo mines at Michoacan which took over the properties after their abandonment in early 1954, has repaid the Mexican government in full for the purchase of the property. Since its beginnings in April 1954, the new firm has constructed 12 miles of mountain road to the highway and begun sinking a new shaft.

Newmont Mining Corp., is now testing nickel smelting facilities at Santa Rosalia, Baja California.

After six months' preparation, during which time a used reverbatory furnace was rebuilt, the first batch of nickel ore was smelted Feb. 14. The ore generally runs 2.5% nickel and slags were shown to contain only 0.09% to 0.11% nickel so the recovery thus far has been good.

Officials were not willing to talk freely and the ore is variously reported to have come from China, the United States, New Caledonia and Canada. Also, the nickel reportedly is destined for Vancouver, B. C. Some 50,000 tons of ore had been shipped into Santa Rosalia by mid-February. The smelter was operating at a rate of 5,000 tons of ore a month.

Santa Rosalia, S. A., is being operated by a Mexican government unit called Comision Fomento Minera. Comision took over the old "El Boleo" mine which became famous as a copper producer under French management.

When the French, because of inadequate ore reserves abandoned the operation, the Comision took over to continue work for the miners. For the past couple of years, government tax subsidies and the high price of copper have permitted Santa Rosalia to continue operation. But of late the falling price of copper had Comision officials concerned. This latest arrangement with Newmont will provide a welcomed source of revenue.

BOLIVIA

Ventures Ltd. of Canada and Vitro Minerals Corp. have announced the formation of a jointly owned company, Bolivex Corp., to explore in Bolivia.

Officers of Bolivex include Dr. J. D. Bateman of Ventures, chariman of the board; Eugene B. Hotchkiss of Vitro, president; James M. Birkbeck, vice president and general manager; William H. Denne Jr., vice president and secretary, and Paul W. Zeckhausen, treasurer.

Directors include Dr. Potter, J. Carlton Ward Jr., Dr. Bateman, William H. Wright and Messrs. Hotchkiss and Zeckhausen.

ARGENTINA

Argentine exports of minerals and ores during 1956 increased 30% in tonnage, and 464% in value above 1955 figures, the Minister of Commerce and Industry, Rudolfo Martinez has announced.

The National Mining Board (Dirección Nacional de Minería) has "adjusted its mission" to the legal changes brought about by the return of mineral rights to the respective provinces, the Minister said at the same time. In spite of this development, he stated, National Mining Board will always have useful work to accomplish in regulating production and promoting commercialization of the country's mineral products.

Solid Combustibles Bureau (Dirección de Combustibles Solidos) has announced the discovery of exploitable coal deposits in three sections of Argentina. The largest deposit of the newly discovered trio

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There's no stop-and-go to interrupt the smooth traffic in water on this freeway built with Naylor Spiralweld pipe.

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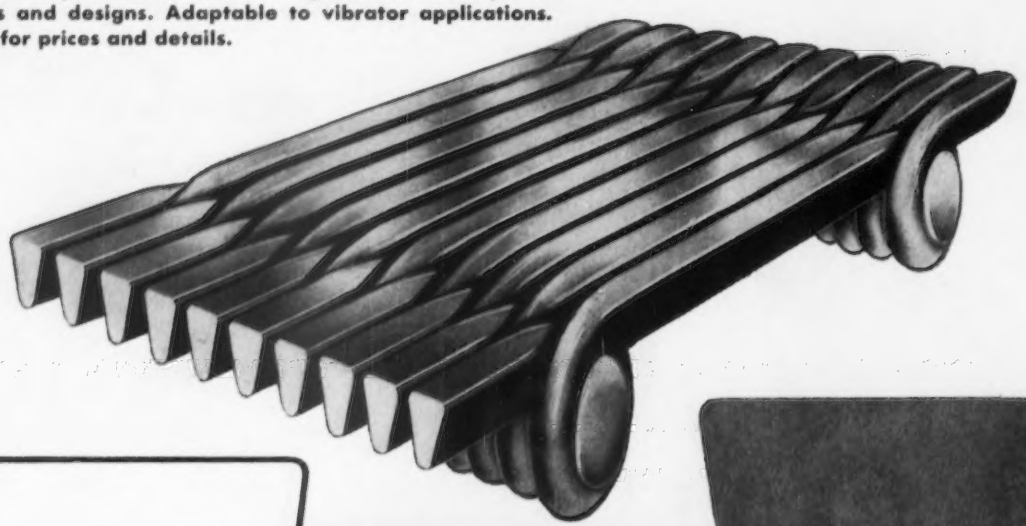

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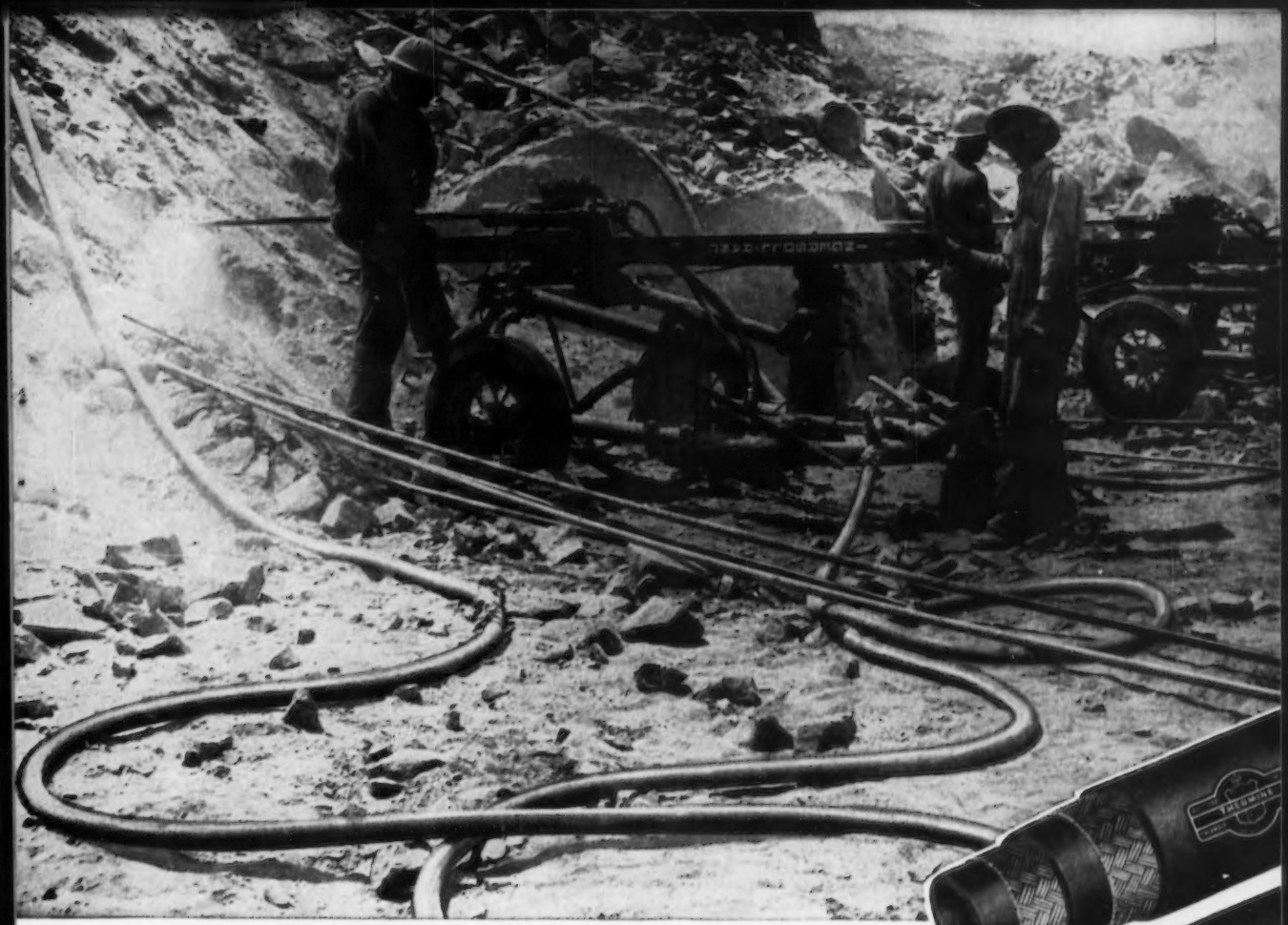

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Mine operators everywhere find Thermoid Hose stays on the job longer—cuts replacement costs and down time. One big reason is quality construction. Another: Thermoid designs hose for specific conditions and uses. Here are three examples:

THERMINE — High pressure air hose. Oil resistant tube is reinforced by heavy duty yarn. Mandrel-built for precision construction and greater strength. Smooth, abrasion resistant cover.

#325 S.B. SUCTION — Heavy duty hose for water suction service. Smooth bore, wrapped hose with heavy wire reinforcement, durable duck plies.

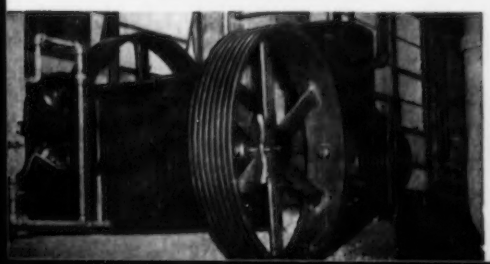
#300 AIR HOSE — Wrapped construction, oil resistant synthetic tube and covers. Heavy duck reinforcing plies. Ideal for use in mines and quarries.

These are typical examples of how Thermoid Personalized Service meets the specific, exacting requirements of the mining industry.

Thermoid

Thermoid Company
Trenton, N.J.

Make Thermoid your choice, too for Multi-V Belts . . .



. . . and Conveyor Belting, specifically designed for the job.

Your Thermoid Distributor can help you select the Hose, Conveyor Belting, Multi-V Belts designed to lower your operating costs.

Hammer Life Increased 7 Times by HARD-FACING

Hammers used to crush limestone and shale remain in operation for 70 weeks now that they are protected with HASCROME high-chromium rod. Unprotected hammers are completely unserviceable after operating for only 10 weeks under the same conditions. The usual maintenance procedure is to recondition the hammers with HASCROME rod about every two weeks—after they have crushed approximately 13,000 tons.

Hard-facing proved to be the economical solution to this typical problem of severe impact and wear. Periodic rebuilding with inexpensive HASCROME iron-base rod resulted in one hammer doing the work of seven, thus saving the cost of six new hammers.

HASCROME rod is widely used to protect rock crushing and earth moving equipment because of its resistance to severe shock and impact. It is a tough alloy which work-hardens to Rockwell C-50, and doesn't chip or spall under heavy impact. The ability to resist mushrooming makes HASCROME rod an excellent build-up rod, too. It provides an excellent shock-proof base for harder, more corrosion-resistant HAYNES hard-facing alloys when severe abrasion or corrosion is the major problem.

See your local dealer for more information on the complete line of 18 HAYNES hard-facing alloys. One of them will solve your wear problem. If you don't know the location of your dealer, write to Haynes Stellite Company, a Division of Union Carbide and Carbon Corporation, Kokomo, Indiana.

See... | **Your local Haynes Stellite Dealer**

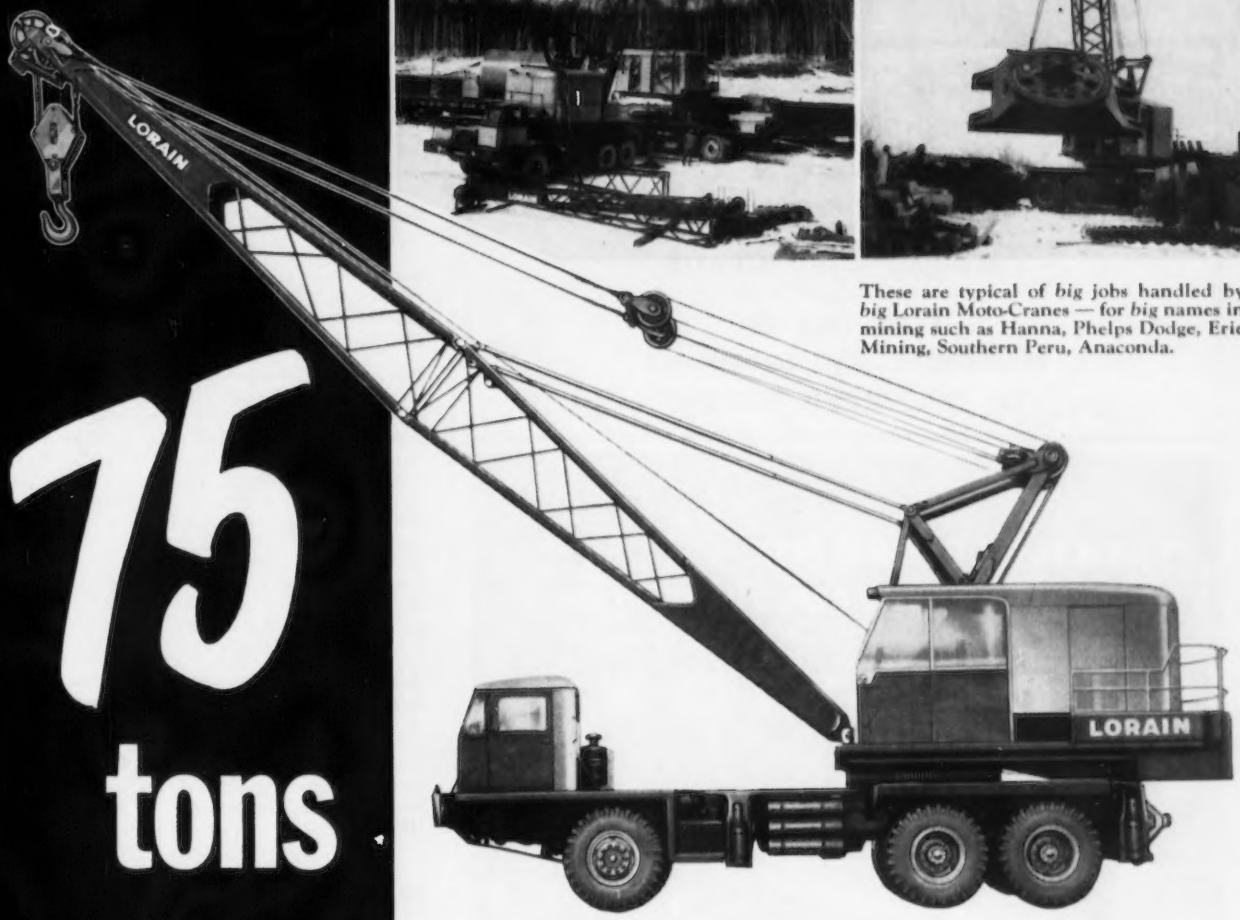
or

Write... | **to Haynes Stellite Company**

"Haynes" and "Hascrome" are registered trade-marks of Union Carbide and Carbon Corporation.

These are typical of *big* jobs handled by *big* Lorain Moto-Cranes — for *big* names in mining such as Hanna, Phelps Dodge, Erie Mining, Southern Peru, Anaconda.

75 tons



LORAIN MOTO-CRANE® MODEL MC-875

NEW 2-LEVER "JOY-STICK" AIR CONTROLS

NEW "SHEAR-BALL" TURNTABLE MOUNTING

NEW SQUARE-TUBULAR-CHORD BOOM UP TO 200 FT.

THROTTLE CONTROL OF LOAD WITH TORQUE CONVERTER

BIG mines that handle big, heavy machinery or construction work need *BIG* crane power and capacity. And they'll find it in this *one* machine that can lift up to 75 tons — use it to replace two or more smaller cranes or other expensive rigging. *BIG* capacity also means longer booms — to reach up to 240 ft. with tip extension.

The 75-ton, model MC-875, is the newest of a *long list* of Lorain Moto-Cranes and embodies all the years of "know-how" acquired by Thew-Lorain, who originated the rubber-tire crane idea in 1918. The MC-875 includes many new and important design features — a few listed above — plus a 12-tire Lorain-designed, Lorain-built Moto-Crane carrier, with 10 speeds up to 20 m.p.h.

For a *BIG* rubber-tire crane to handle *BIG* lifts at your mine, see your Thew-Lorain Distributor for complete facts. Or write for new MC-875 catalog.

THEW LORAIN®

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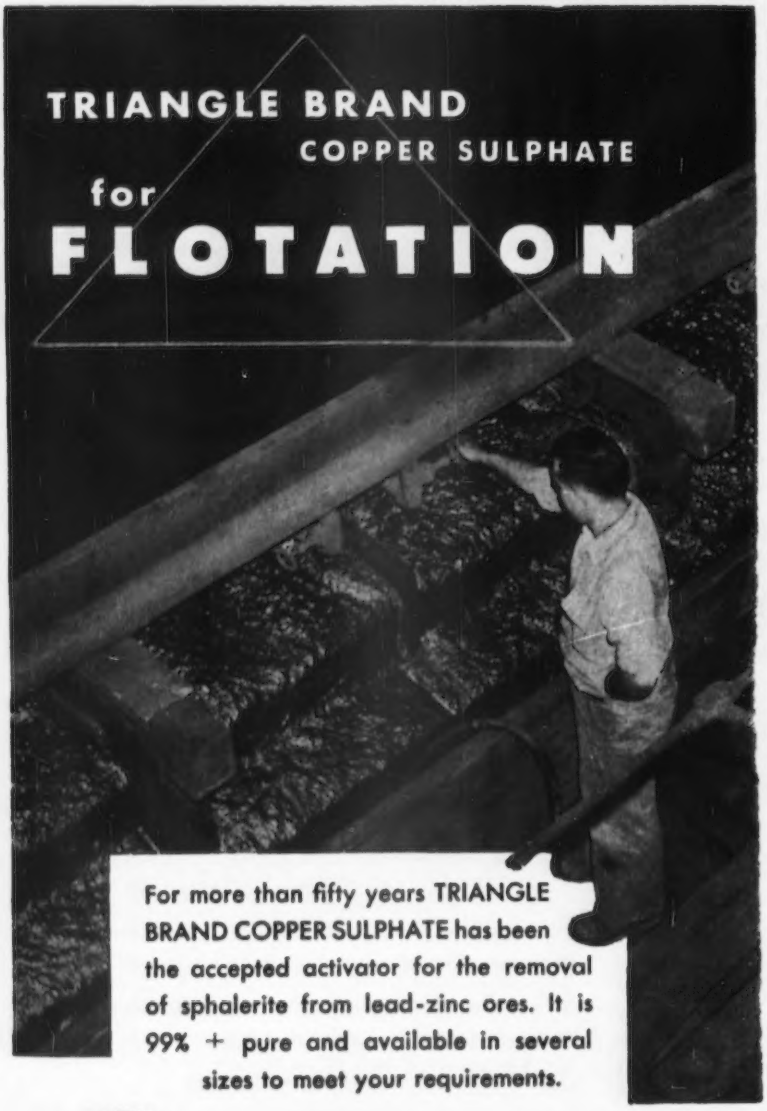
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Argentina *(Continued)*

is in Pico Quemado, in Neuquen, and has an estimated 2.5-million tons; in La Rioja there are some 480,000 tons and in Chubut, 1.15-million tons.

The proved reserves of the Río Turbio mines are 285-million tons, the bureau says, with a probable additional 90-million tons. From 1946 until the 30th of last November, 641,000 tons of coal have been mined there; during 1956 production was 136,501 tons, and production rose last October to the level of 15,500 tons a month.

Production of aluminum sulphate in Calingasta in the Province of San Juan will soon be large enough to make Argentina self-sufficient in this mineral, General Marino Carreras, the Federal Administrator of this Province has announced. Currently, some 50,000 tons a year are being imported, largely for use in water purifying plants. During a recent visit ot Buenos Aires, General Carreras arranged with Central Bank authorities that in the future sulphate of aluminum will be imported at the free market, rather than the preferential, exchange rate.

Reports from San Salvador in the Province of Jujuy say that a private group of mining engineers have obtained a concession to re-open the abandoned borax mines, "Jujuy," "Federico" and "Buenos Aires," which were formerly worked by the Compañía Internacional de Boraxo S.A.

IN THE PHILIPPINES

As usual the Benguet-Balatoc mines dominated gold production in the Philippines in January with combined bullion output valued at over $1,150,000 at premium price, or $686,000 at statutory price. Benguet Consolidated has joined the search for oil in the Philippines and has been granted an oil concession covering some 100,000 hectares in Mindanao. E. O. Bennett, petroleum consultant, will have charge of preliminary exploration work.

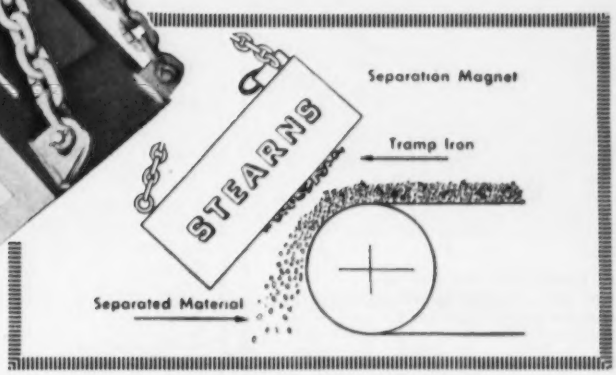
It has been disclosed that Phelps Dodge Corp., Soriano & Co., and Atlas Consolidated will jointly build a plant in Rezal for the manufacture of copper wire and allied products. Atlas Consolidated will furnish copper for fabrication. The new factory will be the first of its kind in the Philippines.

Atlas Consolidated shipped copper concentrates from its Toledo mine in January totaling 5,225 tons, containing 2,040,795 lb of copper. In addition 2,820 tons of pyrites were shipped to the Iligan plant of the National Power Co. Shipments from the company's Mati iron mine totalled 17,700 tons. Total value of all shipments of mineral products was $884,000. Copper production in January was down because of flood conditions during the month and grade of ore milled fell

STEARNS SUSPENDED MAGNET

gives you cleaner ore —even on fast conveyors!

Magnet can be suspended at head pulley of conveyor, in position shown, or anywhere along the belt. At right, principle of operation of Stearns rectangular suspended magnet. Optional cable suspension for easier control of angle.



A Stearns rectangular suspended magnet gives you positive and efficient removal of tramp iron — even on heavily loaded, fast conveyor lines.

The Stearns rectangular magnet design permits its powerful, deep-penetrating magnetic force to remove tramp iron effectively from entire width and depth of material burden at belt speeds in excess of 600 fpm. The magnet operates efficiently where other equipment can't do the job.

Greater Flexibility

Stearns suspended magnets overcome space limitations because they can be placed over head pulleys or anywhere along the belt. Some are installed to remove tramp iron before material moves onto the conveyor—thus safeguarding the belt and other processing equipment from damage.

Stearns suspended magnets are economical to install and operate. There's no need to modify your existing conveyor systems.

Standard or Custom-Built

Magnetic specialists at Stearns design and build rectangular or circular suspended magnets, electro or permanent magnetic pulleys in standard sizes — or to your specifications. Get complete details from your Stearns representative.

Check these advantages:

- *All-welded, moisture-proof construction*
- *No moving parts that require replacement*
- *Single-coil construction for magnetic field stability*
- *New design of magnet coil enclosure affords maximum heat dissipation*
- *Vacuum-impregnated windings for long life, dependable operation*

FREE BULLETIN AIDS SELECTION

Send today for new bulletin describing five major types of Stearns suspended separation magnets. Gives you complete specifications and simple method of selecting the proper size and type of magnet for your application. Ask for Bulletin 1031-D

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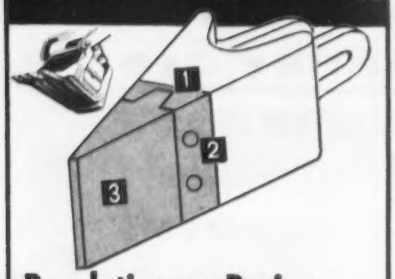
Bulldog Replaceable Digger Teeth

CUT INVENTORY AND REPLACEMENT TOOTH COSTS UP TO 65%



Revolutionary Design Has Just 3 Parts

1. ***Universal Weld-On Adapter*** **uses old tooth as a base. Saves the cost of conventional adapter or new tooth. Same adapter fits on several different types of equipment. Easily welded on worn teeth.**

2. ***Positive Lock Pins*** **that give a tight fit to the replaceable tooth and are easily removed for replacement.**

3. ***Easy Change Replaceable Tooth****,* **changed with a hammer and punch. Has reversible bevel point. Made of highest quality alloy steel — heat treated to outwear all other teeth. Field tested in taconite mines under toughest abrasive conditions, Bulldog Teeth have consistently shown cost savings up to 65%.**

YOU NEED ONLY A FEW ADAPTER SIZES TO FIT ALL POPULAR MAKES OF

Shovel Dippers	Dragline Buckets
Back Hoe Buckets	Clamshell Buckets
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For descriptive folder, technical data, prices, and name of your nearest dealer—

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Sales Representative and Distributor Inquiries Invited

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Philippines *(Continued)*

to 0.55% copper. However, February saw a rapid recovery, with daily tonnage milled reaching a peak of over 8,000 tons.

Copper production at Lepanto Consolidated came to 2,144,270 lb copper and 5,924 oz gold in January. Ore milled totalled 36,239 tons with an average grade of 3.1% copper and 0.13 oz gold per ton. Copper recovery was 94.5% and 82.6% of gold.

Shipments of copper concentrates increased over 50% in 1956 with Japan showing a 200% increase over its purchases in 1955. Shipments to the U.S. were only slightly larger. Lower freight rates to Japanese ports give a competitive advantage to Japan when bidding for concentrates against American smelters. Likewise, shipments of chrome ore rose at a faster rate than to U.S. All shipments of iron ore from the Philippines are consigned to Japan.

Construction work for the 275-ton mill of the Hexbar Mining Co. of Rapu-Rapu Island, Albay province, has been completed and machinery is being rapidly installed by Engineering Equipment & Supply Co. Conventional milling methods will be employed, followed by selective flotation for the copper concentrates. Ore reserves are reported at over 300,000 tons of 3% copper. Recent stripping has disclosed additional ore.

A new chromite mine, Palawan Consolidated, shipped 1,500 tons of metallurgical grade chromite to U.S., bringing total shipments to 5,000 tons valued at $274,000. Property is controlled by Marsman & Co.

Sipalay project of Marinduque Iron Mines has exposed by stripped an estimated 14-million tons of 1% copper ore at Binulig Ridge. A 4,000-ton mill has been erected and was to begin in February. All equipment was bought in the U.S. Construction of the mill and installation of equipment required a year's time. The entire cost of the plant exceeded $5-million. Production is estimated at 1,670,000 lb of copper per month when in full operation. Jesus S. Cabarrus is president of the company. James E. Atkinson, formerly with Benguet, has been named as general superintendent of the company.

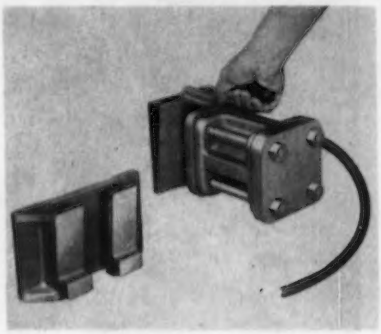
A new mining company, Northern Luzon Mining, has been formed to develop manganese claims in Cagayan. Ore is said to average over 50% Mn. Foote Mineral Co. of Philadelphia is reported to be interested in buying the ore.

IN AFRICA

Behind a well-guarded, floodlit fence 22 miles outside Johannesburg more than 200 people are working day and night in a $3-million plant to produce uranium oxide for the Western world's atomic reactors.

The plant is exporting 4,400 short tons

CLEVELAND'S NEW PORTABLE VIBRATOR



Lightweight Well-Balanced

Having trouble with materials sticking in your portable bins or trucks? The Cleveland Type LSRRH Portable Vibrator is just what you've been looking for. This lightweight, well-balanced portable is designed for equipment such as concrete forms, septic tanks or large pipe forms that do not require a permanent vibrator installation.

The Cleveland Type LSRRH Portable Vibrator develops 7000 to 8000 vibrations per minute, maintaining a free flow under all conditions. A cast steel bracket holds the LSRRH securely in place, making it ideal, even for heavy duty use.

For more detailed information, write for our illustrated catalog.

This new portable vibrator is just one of The Cleveland Vibrator Company's complete line of air and electric vibrators. You'll find a type and size vibrator for your every requirement.

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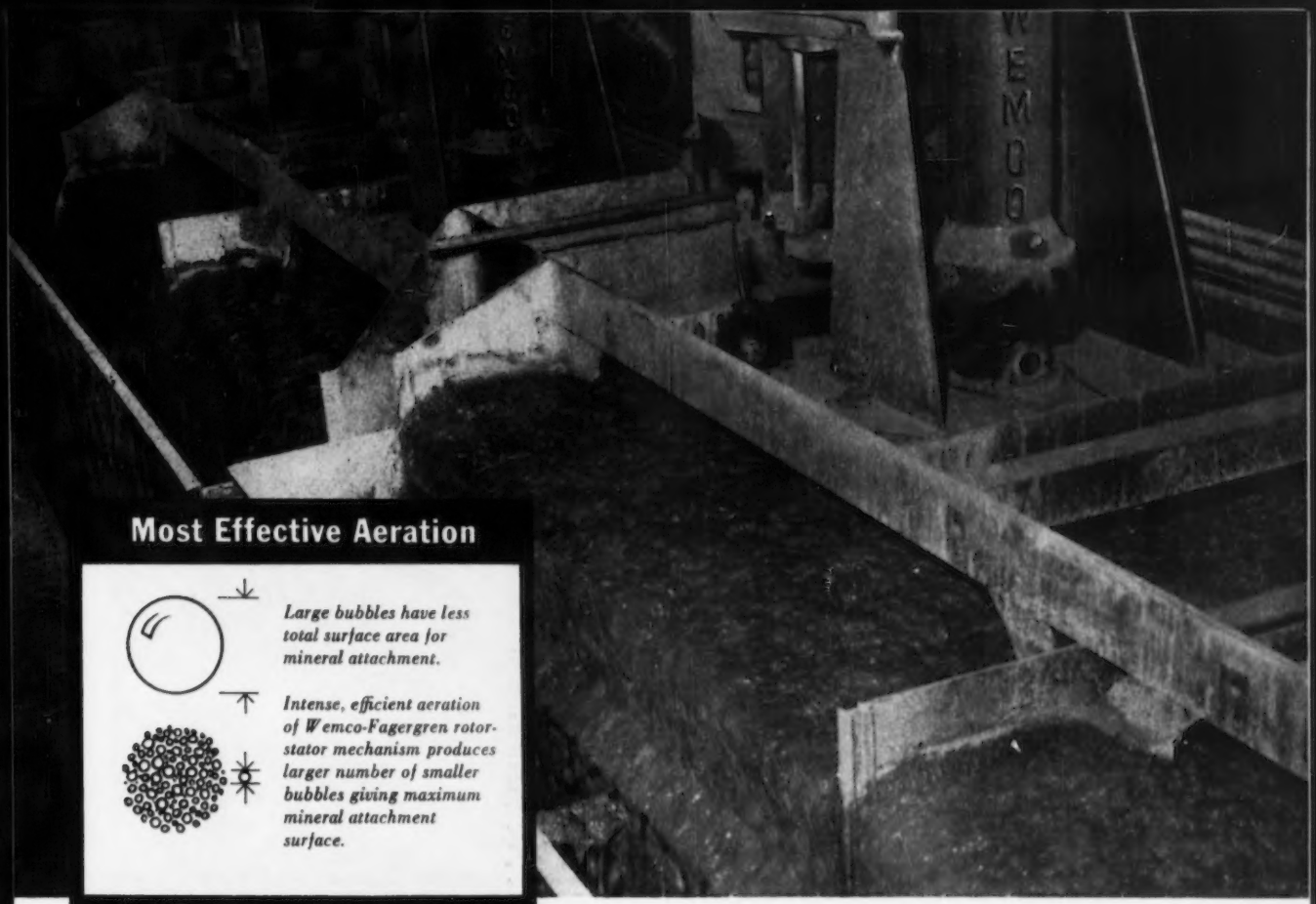
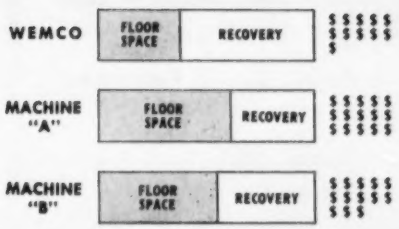


Most Effective Aeration

Large bubbles have less total surface area for mineral attachment.

Intense, efficient aeration of Wemco-Fagergren rotor-stator mechanism produces larger number of smaller bubbles giving maximum mineral attachment surface.

Greatest Recovery per Dollar



Highest Recovery of Values

1.5% more molybdenum
1.0% more copper
5.0% more silver
1-2% more gold
— with Wemco

by every competitive test... Wemco Fagergren proves best

In recent, rigorous testing with top-notch competitive equipment, Wemco Fagergren Flotation Machines proved best in recovery, grade, floor space, cost and maintenance — as the following test results indicate:

"... One goal of the test was *recovery*, without sacrifice in grade, and the *Wemco Fagergrens consistently led in this factor.*

"... as the test progressed there was a trend to increase tonnages of feed per machine. As these tonnages were increased, operating horse-power increased on all machines *except the Wemco Fagergrens.*

"... mechanical and design changes were made on several occasions in (two of the competitive) units. During the testing program *there were no mechanical revisions or design changes on the Wemco Fagergrens.*"

- And as final proof of their superiority, Wemco Fagergrens also excelled on such important counts as *simplicity of operation . . . least total number of mechanisms required . . . longer effective life of wearing parts.*

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Manitowoc 4500 Boosts Mining Output

Smart mine operators with an eye on output figures have found that the Manitowoc 4500 loads out more tonnage faster — at greater profit. Here's a true mining machine — always ready to increase output — either as a 5½-yd., big capacity shovel, or a long reach, 6-yd. dragline.

FIRST WITH UNIT DRIVE. The Manitowoc 4500 is powered by a single diesel engine instead of independent electric motors and accessories. You get greater operating efficiency — less power loss with unit drive, pioneered and developed by Manitowoc for large crawler excavators.

UNMATCHED SIMPLICITY. You're rid of all the headaches and special maintenance problems brought on by electric drive. Several electric motors, generators, control boards and thousands of electric wires and connections are eliminated. Your regular mechanics easily handle routine maintenance and servicing.

"SMALL MACHINE" MOBILITY. Working range on the job is extended because there's no restrictive trailing cable — no need to stay close to power installations. When moving between jobs, the unit can be shipped on railway cars or highway trailers — then set up, ready to go, in less than a week.

Discover why more and more mines are switching to Manitowoc — Contact your distributor now!

Manitowoc Engineering Corp., Manitowoc, Wis.

- **Simple Design Throughout for Full Power — Less Deadweight — Less Downtime**
- **High Lift Booms Extend Reach and Height**
- **Tubular Dipper Stick Evenly Distributes Digging Strain**
- **Only 15 Gears and Sprockets — Only Working Gears Turn**
- **Amazingly Low Ground Pressure With Extra Long, Wide Crawlers**
- **Torque Converter Drive — Air Controls — Eliminate Operator Fatigue**

MANITOWOC

SHOVELS 1 - 5½ YD. Speedcrane CRANES 20-100 TON

New Forward Control Design provides more space because the engine is behind you. It puts a 74" pickup box on 81" wheelbase—record-breaking cargo space per inch of wheelbase. This efficient design makes maneuvering through rough terrain faster and safer.

How the New Forward Control 'Jeep' FC-150 speeds your tough mining jobs!

All-Wheel Traction. With the extra traction of its 4-wheel drive, the FC-150 travels through mud, sand, soft earth, and climbs hills as steep as 65% ... in good weather or bad. Yet, it shifts easily into 2-wheel drive for highway travel at top legal speeds.

On job after job, the all-new Forward Control 'Jeep' FC-150 keeps mining jobs on schedule with savings of time and manpower. That's because it's made to order for every phase of mining operations.

Here's a 4-wheel drive truck that gives you maximum cargo space on minimum wheelbase. It maneuvers through the heavy, rough going of mining projects, with crew and equipment, where ordinary trucks call it quits. Riding comfort!—you have to test drive it to believe it! There's plenty of head, leg, and shoulder room! The all-new Safety-View cab lets you see terrain as close as 6 feet from the front bumper. It combines with the new wrap-around windshield—largest in the FC-150 weight class—for up to 200% greater forward visibility. With power take-off, the FC-150 operates a variety of special equipment from winches to portable drills.

The new 'Jeep' FC-150, G.V.W. 5,000 lbs., is powered by the economical engine that made 'Jeep' vehicles famous. It combines with a new 16-gallon gas tank to let you cruise up to 300 miles on *one* filling. See your 'Jeep' dealer for a demonstration!

There's a 4-Wheel-Drive 'Jeep' vehicle for your job!

Universal 'Jeep'

'Jeep' Truck

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'Jeep' / *Forward Control*

4 Wheel-Drive **FC-150**

WILLYS... world's largest makers of 4-Wheel-Drive vehicles

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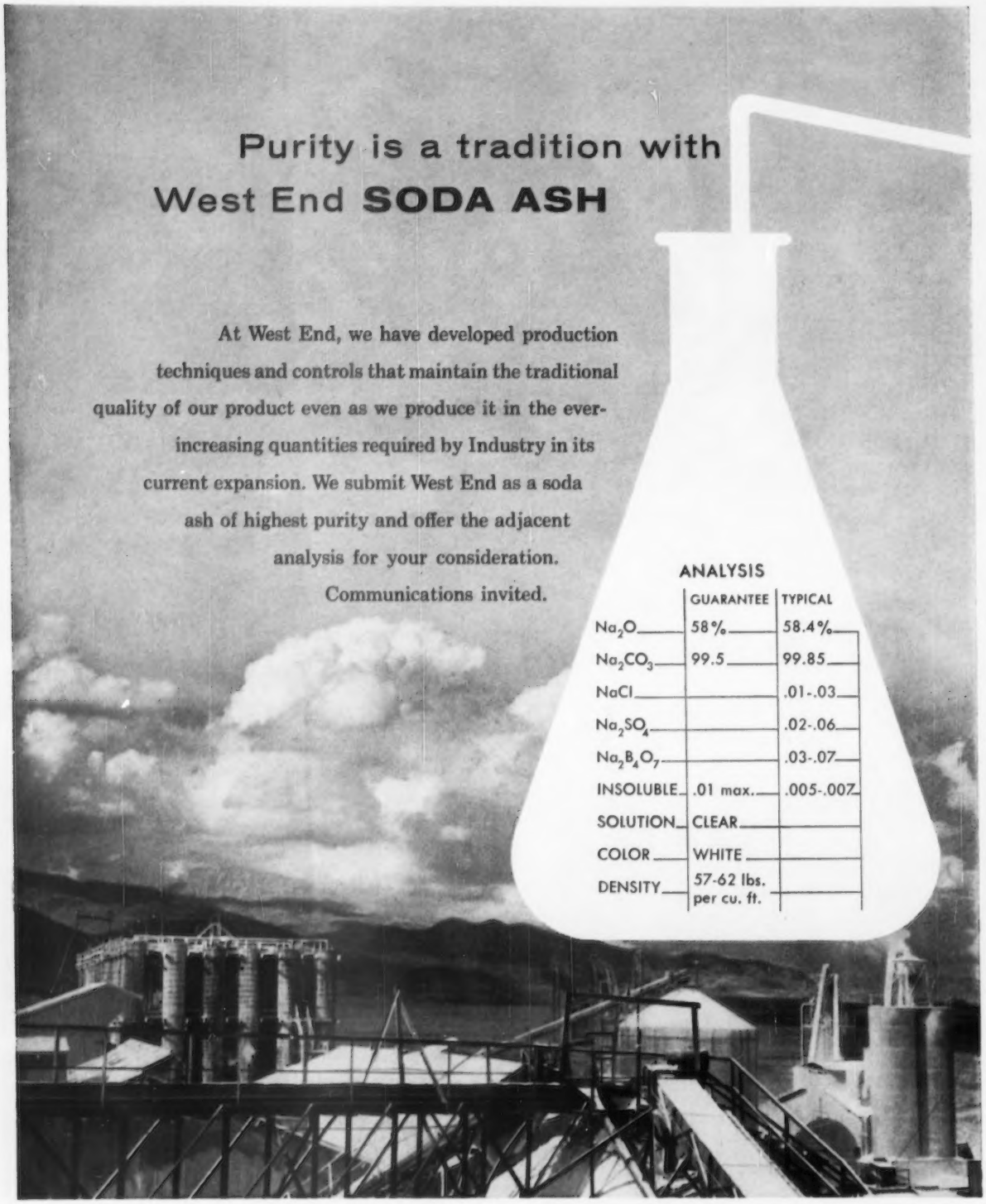
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RUGGED BUTYL INSULATION plus neoprene jacketing gives this ANACONDA Mine Power Cable long life under rugged conditions: 60-ft. drop over rocky cliff, unprotected from sun or weather in northern open-pit mine.

BUTYL INSULATION MEANS LONGER LIFE

This Cable is as tough as the terrain looks!

Experience shows that in high-voltage mine power cable, the insulation must provide not only good ozone resistance but *mechanical strength* as well.

The unusual tensile strength and inherent ozone resistance of Anaconda's butyl insulation means the strongest, sturdiest mine power cable ever offered you.

In addition, this insulation resists heat, moisture and has high dielectric strength. Over the insulation is a tough, abrasion-resistant neoprene jacket—engineered from years of testing in our own mines.

NEW ENGINEERING BULLETIN EB-27 has full details on performance of Anaconda butyl insulation in 15 Industry Specification tests. Ask the Man from Anaconda for your copy as well as more information about ANACONDA Mine Power Cable. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

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DISTRIBUTOR FOR **MINE POWER CABLE**

"TOPS" by EVERY TEST

Capacities to 150 G.P.M.

Heads to 600 Ft.

AURORA® APCO Two Stage Pump for High Pressure Service

APCO is the highest development of the Turbine-Type Pump. Unsurpassed for small capacity high head duties. Handles non-lubricating liquids almost indefinitely without wear. Suited to "1001" duties. Write for Bulletin 111 or Condensed Catalog "M".

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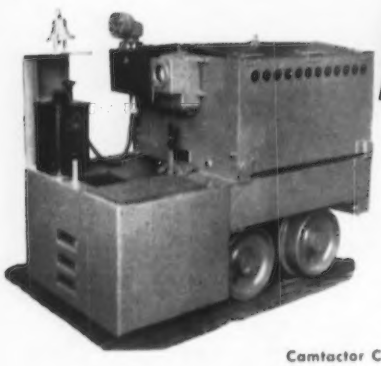
...helps beat rising tonnage costs



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Atlas Type J Trammers give you efficient multi-level service with ruggedness and power to meet rigid schedules despite most adverse mine conditions. Their low price is matched by outstanding operating and maintenance economy. Learn today how Atlas can help hold down tonnage costs.

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Africa *(Continued)*

of dry weight uranium oxide every year. In safe, granular form, it goes out in black drums for delivery to ports overseas where it is refined into purer form from which uranium metal may be made or the isotopes of uranium separated.

Production at the plant began in February 1953 but it was kept a close secret. Its existence has now been made public for the first time.

The plant operates under the combined development agency, formed by the British and American Atomic Energy authorities. It is governed by a board of directors under the chairmanship of R. B. Hagart.

Large new deposits of tantalite have recently been discovered in the vicinity of Karrasburg, South West Africa by two prospectors while on routine diamond prospecting work.

The prospectors are employed by a diamond company mainly concentrating on prospecting for diamonds in an area over which it has obtained a concession.

No. 2 shaft at the Virginia Gold Mine in the Free State is to be deepened 400 ft to enable the mine to reach is maximum reef milling capacity of 125,000 tons a month. The mine is milling about 95,000 tons a month at present.

Deepening will include the opening up of the ground between No. 2 shaft and No. 3 shaft. Ventilation in the No. 1 shaft will also be improved.

High uranium borehole results up to 229 in.-lb have been disclosed in the drilling program on the Rietkuil section of Afrikander Lease. This was announced in a circular sent to shareholders of Central South African Lands & Mines and Tanganyika Central Gold Mines. The circular gives full details of the development program and a scheme for the provision of capital and the acquisition of Tank Central's 40% interest in the block B.2 in which the Rietkuil section is located.

A potential $75- to $90-million copper project is being considered by Newmont Mining Corp. interests and Rio Tinto at Phalaborwa Transvaal, according to Marcus D. Banghart, vice president of Newmont and managing director of Tsumeb Corp. and O'Okiep Copper Mine Corp.

Discovery was originally studied by Safari Explorations, a 50-50 company owned by Tsumeb and O'Okiep. New firm, made up of Rio Tinto and Newmont and American Metal Co. will spend an initial $3-million investigating the find.

Minerals produced in Northern Rhodesia last year are valued at $367,650,000, an increase of $25,650,000 on production in 1955. The value of electrolytic copper produced was $210,045,000 and of blister copper $134,520,000.

De-watering operations have started at the flooded Merriespruit Mine at Virginia in the Free State. More than 100-million gallons of water had to be cleared out of the mines.

Before baling operations started it was feared that the heavy strain put on the motors of the winding gear through a

NEW!

GARDNER-DENVER R68

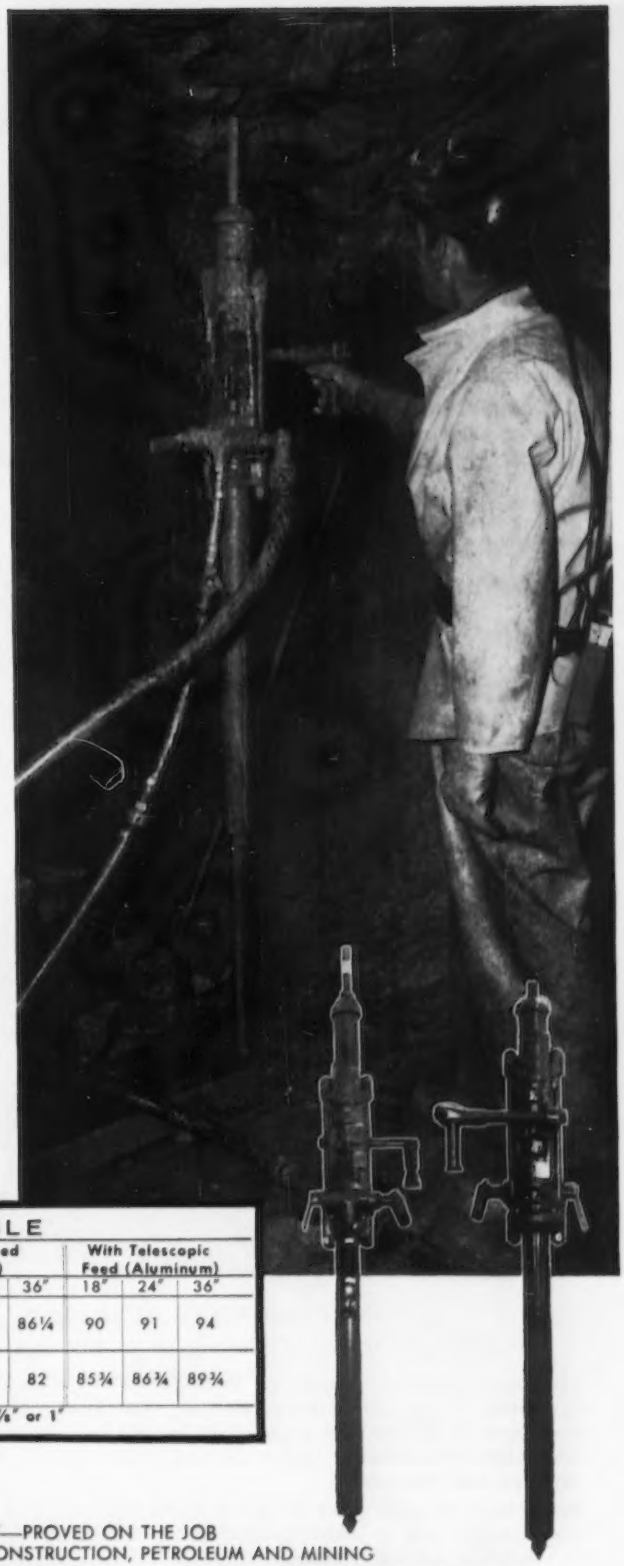
New drilling speed
New ease of operation

Here's a new stoper with added automatic features that increase drilling speed and handling ease. The new R68 has all of the rugged strength, operational efficiency and top manufacturing qualities of all other widely used G-D stopers—another example of Gardner-Denver engineering foresight.

New R68 features:

1. Gardner-Denver automatic water control—operating on the "water on—air on; air off—water off" cycle.
2. Push-button or rotary type feed controls.
3. Equipped with automatic blowing through chuck end—keeps mud and abrasive cuttings out of drill.
4. Is available with collared or tappet chuck. Your choice of direct or telescopic feed.

Write for complete details.



SPECIFICATION TABLE

Model R68	With Direct Feed (Steel)				With Direct Feed (Aluminum)				With Telescopic Feed (Aluminum)		
Steel Change	18″	24″	30″	36″	18″	24″	30″	36″	18″	24″	36″
Weight: (With Tappet Chuck) lb.	94	97	100	103	80¼	82¼	84¼	86¼	90	91	94
Weight: (With Collared Chuck) lb.	89¾	92¾	95¾	98¾	76	78	80	82	85¾	86¾	89¾
Steel Sizes: Hex or Q.O.—⅞″ or 1″											

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Commercial Ores Co has been successfully washing kyanite for several years with an EAGLE Single Screw Coarse Material Washer-Dewaterer, preparatory to flotation in their mill. Performance is satisfactory—maintenance cost is low.

Eagle Fine Material Washer-Classifier-Dehydrators, Coarse Material Washer-Dewaterers and Eagle Log Washers are performing admirably on a variety of ores in the U. S. and for foreign countries.

Eagle Single and Double Screw Fine Material Units up to 54" Screw Dia., Single and Double Screw Coarse Material Units up to 36" Screw Dia. and Log Washers up to 48" log dia. are described in Cat. 55. WRITE FOR IT.

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5 TON HIGH TYPE MONITOR

Available in 3 to 12 tons: 42 to 48" high, 18 to 56½" track gauges.

Greensburg's dependable performance results in operating economy. Advanced engineering design and custom-building to specifications give Greensburg Locomotives up to 20% more efficiency and longer battery life than any other storage battery locomotive of equal weight and battery capacity. More earning power per dollar invested!

Built in single or double motor drives with double equalizers, drum or contactor type controllers, with or without dynamic braking, Greensburg Locomotives will haul more and cost less to operate!

Send us your haulage problem today!

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Africa *(Continued)*

large number of short lifts would cause the motors to overheat.

Special ventilating equipment was built around the motors to minimize this danger and after 15 hours continuous working there was no sign of overheating.

Because of this, the capacity of the steel balers was increased and extensions were fitted to lift 2,600 gallons at a time.

It was hoped to bale out water at the rate of 5-million gallons a day but this is now likely to be exceeded. Officials engaged on the baling operations say it is too early to calculate the ultimate success of the project as there is no means of knowing how much water may still come in through the fissure about 3,000 ft down where the original flooding started.

Government of Northern Rhodesian in Central Africa has announced an intensive search for radioactive minerals to be made in the country during 1957.

Direct U.S. financial stake in the Federation of Rhodesia and Nyasaland is now in the region of $126-million, and indirect investment amounts to considerably more, according to Curtis G. Strong, U.S. Consul in Salisbury. Strong said that $56-million of the direct financial stake was in the form of U.S. Government loans made since 1949. These include loans for the development of the rail link between Rhodesia and the Portuguese East African port of Lourenco Marques, the expansion of copper and cobalt mining in Northern Rhodesia, the expansion of electric power on the Northern Rhodesian Copperbelt, and new equipment for the Rhodesian railroad system.

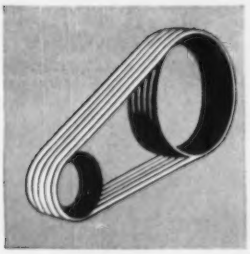
A Tokyo refinery has ordered one year's output from the Macalder-Nyanza mine of Colonial Development Corp., Lake Victoria, Kenya. Order involves shipment of more than 2,000 tons copper, with the first 350 tons to leave Mombasa in March. Shipment will consist entirely of cement copper reportedly containing some 70 to 80% Cu.

According to the Division of Mines, Republic of France, Moroccan mineral production in 1956 was as follows:

	Tons
Phosphate (Khouribga)	4,257,266
Phosphate (Louis-Gentil)	1,264,551
Lead minerals	120,047
Zinc minerals	70,921
Metallurgical manganese	383,115
Chemical manganese	38,294
Ferro manganese	2,462
Iron minerals	489,690
Iron oxides	1,173
Pyrites	1,548
Cobalt minerals	6,438
Copper minerals	2,863
Gold (kilograms)	8.2
Tin minerals	8
Tungsten minerals (kg)	3,795
Barytes	29,594

E. J. Longyear Co., consulting mining engineers and geologists, early this year completed their contract with the Portuguese government for the reconnaissance mineral survey of 140,000 sq km in the provinces of Angola and Mozambique.

Areas covered included three in



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No V-belt transmits power like *TEXROPE* BELTS with endless grommet construction

THICK, solid rubber cushion surrounds and protects grommets from heat, shock and other destructive factors.

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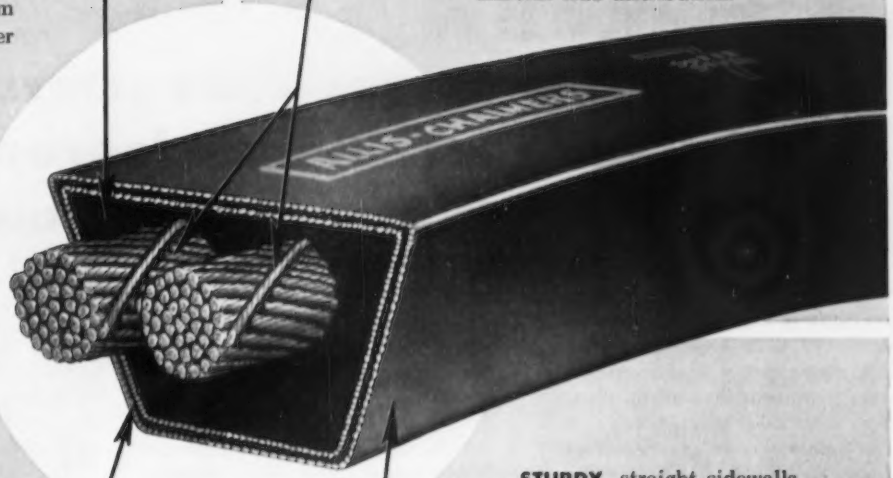
EXTRA STRONG, heavy twin grommets each offer more than enough tensile strength to handle any load normally encountered. They're precisely located to assure uniform load distribution.



TOUGH bias-cut, multi-fabric cover prevents penetration by heat.

Tough

Sturdy

STURDY, straight sidewalls guarantee maximum gripping power. Tendency to bulge is converted into gripping sidewall pressure because cast-iron sheave sidewalls confine the belt.

Texrope is an Allis-Chalmers trademark.

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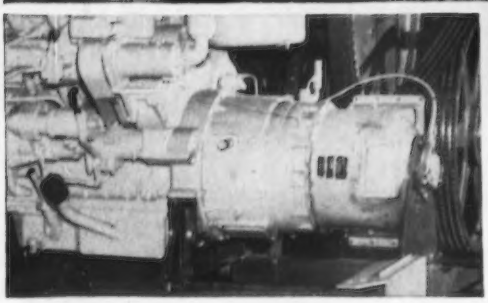
ALLIS-CHALMERS

A-5269

Equipped with a Twin Disc Torque Converter, this 2½-yd. Lorain L-85 Shovel is working on heavy highway grading near New Stanton, Pennsylvania, for Lycoming Construction Co., Williamsport.



Inset (left) is a Cat D337 Diesel Engine-Twin Disc Torque Converter combination which is available in the Lorain L-85.

How torque converters *assure* higher dividends from your major equipment investments

Twin Disc Torque Converters, dependably and efficiently transmitting power to your heavy-duty machinery, *assure you a higher return* on your equipment investment, through *more work done in less time* . . . with a *minimum of maintenance and costly downtime.*

Here are five profitable, proved reasons why Twin Disc Torque Converters help you to earn *more* from your other equipment investments . . . such as the Lorain L-85 Shovel pictured above.

1. The torque-converter eliminates lugging and stalling . . . permitting engines to work in the maximum efficiency range *all* the time, delivering *constant* high-horsepower output—getting more work done.

2. Experience has proved that *smooth* converter power reduces peak loads throughout the shovel drive train because fluid within the converter absorbs much of the impact energy resulting from a quick drum speed change . . . thus protecting *both* driving and driven equipment.

3. When necessary, the torque converter smoothly delivers approximately twice normal torque to the drum, which, at slow digging speed, represents an important advantage in power delivered to the dipper.

4. Cable life is extended since no sharp impact loads ever reach cables through the torque converter. Constant line tension is maintained . . . there is no jerking or snapping.

5. An infinite variety of ratios is available to work with, permitting smooth, accurate control of loads and delicate "inching" or "holding" under power.

Specify a torque converter in *your* next new machine, or when you repower. And investigate the advantages of Twin Disc Torque Converters—both single-stage *and* three-stage—for most other heavy-duty applications from 30 to 1000 hp.

For details, request Bulletin 508 and 135-E (single-stage and three-stage respectively.)

TWIN DISC

TWIN DISC
Torque Converters

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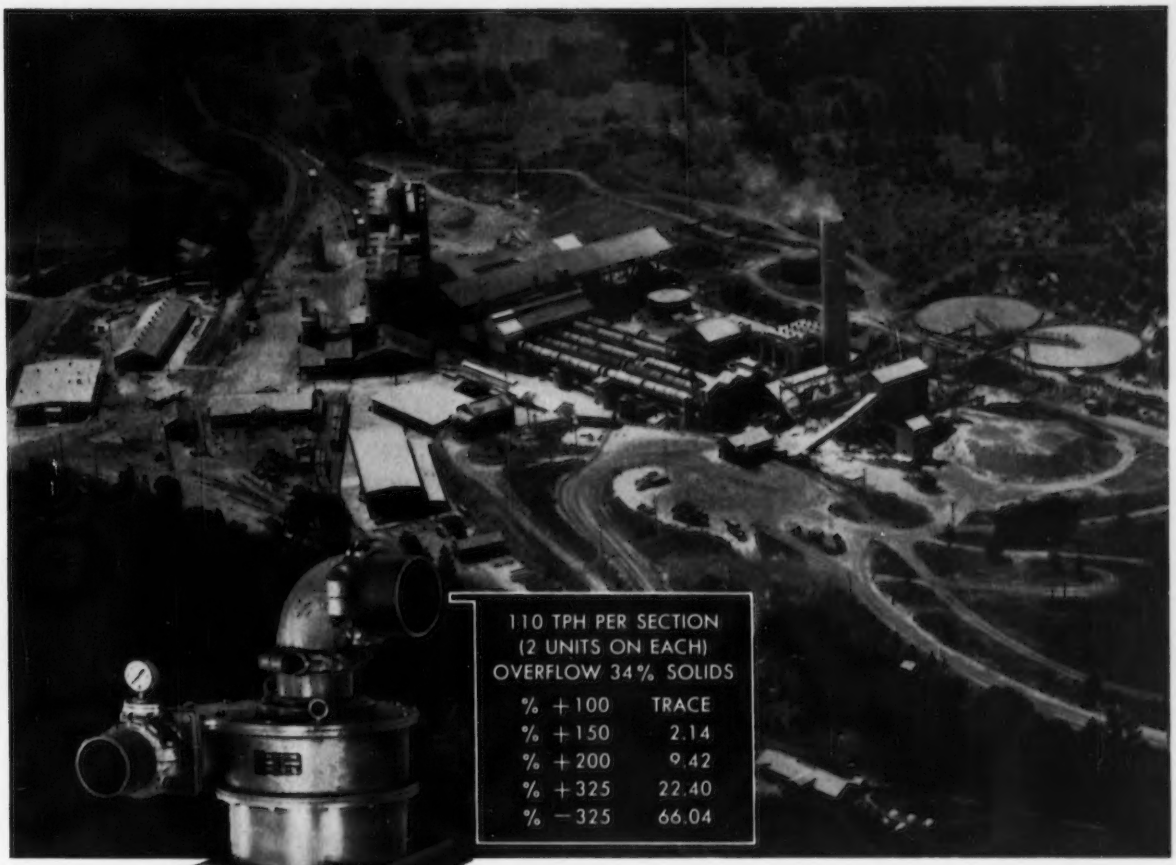

110 TPH PER SECTION (2 UNITS ON EACH) OVERFLOW 34% SOLIDS	
% +100	TRACE
% +150	2.14
% +200	9.42
% +325	22.40
% −325	66.04

closed-circuit classification to 88% −200 mesh at 34% solids with Krebs Cyclones

Calaveras Cement Company, the largest mine ever to operate in California's historic Mother Lode, makes another major contribution to milling technology. In 1956, capacity per section at Calaveras was stepped up from 80 to 110 tons per hour. This called for better classification. Krebs Cyclones, model D20B, especially fitted to meet the objectives were installed. Tramp sizes in the final product are only a trace on 100 mesh even with high density at 34% solids compared to a previously fluctuating 11 to 16% solids. Only 26% as much water is required. Kwh per ton for classification and pumping to the thickeners has dropped 38%. Pressure requirement at cyclone inlet is 11 psi. Krebs Cyclone operation is simple; grind-out time on shutdown is eliminated. Maintenance after a year has been negligible.

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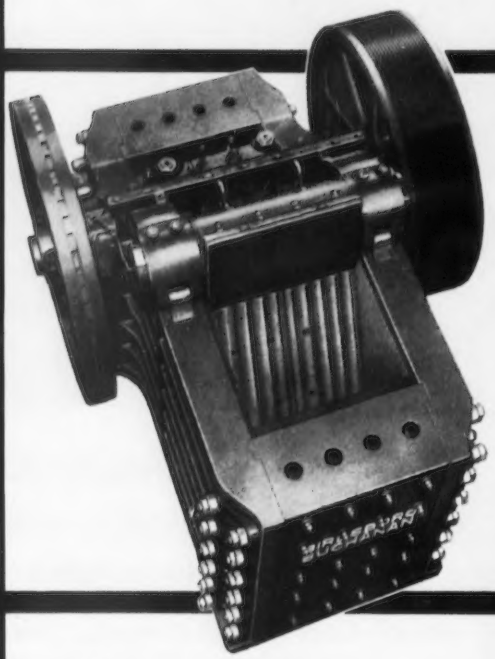
1 Deep, extra strong cast steel frames.

2 Longer, swing jaw for more acute crushing angle.

3 New, removable water-jacketed main frame bearings.



4 Rod type pitman, lighter and stronger, cuts power costs.

5 Automatic lubrication force feed to every bearing—no shut-down for grease jobs required.

6 New three-piece toggles cut replacement costs.

7 Extra large forged steel shafts for maximum bearing area.

8 Offset toe lugs allow extra wear on jaw plates.

9 Interchangeable and reversible jaw plates for additional wear.

10 Entire crusher precision constructed for easy field assembly.

For fast, high production with minimum maintenance, always look to a powerful, ruggedly-built BIRDSBORO-BUCHANAN Deep Frame Crusher. Available in sizes from 24″ x 36″ to 66″ x 84″. CR 5-55

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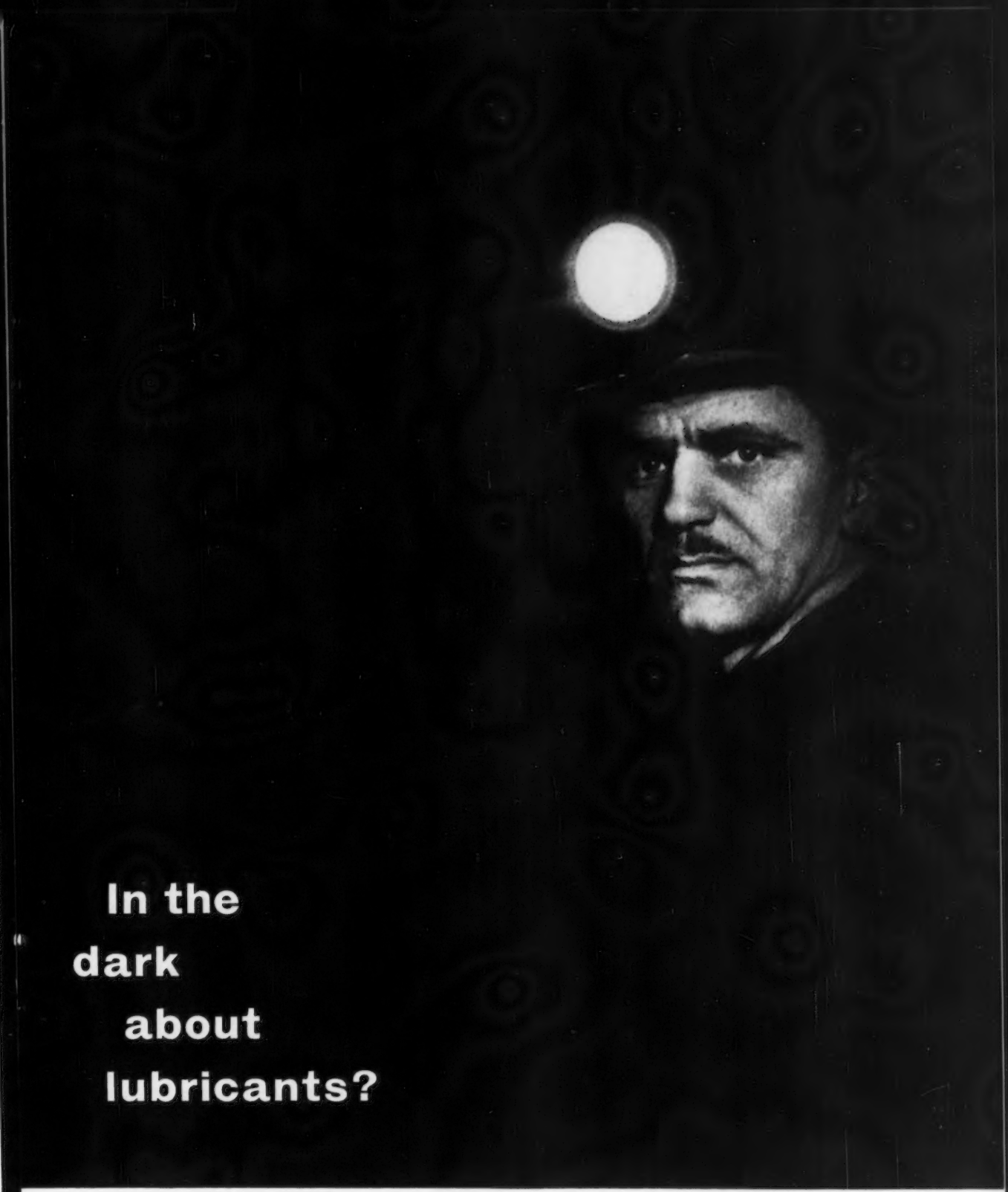

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Africa *(Continued)*

Angola and two in Mozambique. The reports are in five volumes and the maps accompanying these reports comprise in total an area of almost 2½ acres of cartography.

These reports and maps are on file with the U. S. Geological Survey in Washington, D. C.

IN AUSTRALIA

Expansion under way and in various stages of planning is expected to place Australia in the second or third place as a world producer of ilmenite.

Current installed capacity of two main West Australian plants is in the vicinity of 120,000 long tons of ilmenite concentrate annually, and the installation (by late 1957) of a second magnetic and electrostatic separator by Cable Ltd. will raise that company's capacity to 90,000 long tons annually.

Western Titanium N.L. is already planning further expansion and Westralian Oil Ltd. is considering the construction of a plant for the production of concentrates. By mid-1958 the combined capacity of all West Australian plants will reach 250,000 long tons of ilmenite concentrate annually.

Australian domestic requirements are in the vicinity of 25,000 tons a year and during 1957 the bulk of the ilmenite to be shipped will go to Japan. Official Australian sources expect that Europe, U.K. and, perhaps, the west coast of the United States will become Australia's main customers but shipping availability and freight charges are worrying the authorities and producers alike. Recent European inquiries, however, have been on the f.o.b basis and at highly attractive prices.

South Australian government is conducting negotiations with a large overseas firm to commence major uranium operations at Crockers Well, north of Radium Hill, South Australia.

The contract which is likely to be signed involves the entire Crockers Well area. It will be operated as an open cut proposition and mining would comprise both high and low grade ore. A plant will be erected to concentrate the ore at Crockers Well and concentrates will be treated at Port Pirie, South Australia.

A deep shaft is being currently drilled at Crockers Well to obtain more information on the nature of the ore at lower depths.

Capital already invested in the Australian uranium industry is officially estimated to total almost $70-million and prospects are excellent for a further investment.

The estimate was disclosed by the Australian Minister for National Development Senator W. H. Spooner. He said that when the Mary Kathleen mine began operations, Australia would be producing about 1,000 long tons of uranium oxide a year. This is the first estimate ever disclosed. The achievement of this

Stemming material delivered by 2¼-yd. Michigan 175A

Commutes 2 miles between Arizona pits . . .

Versatile Michigan pays for itself on a multitude of open pit jobs

This 2¼-yd. Michigan Tractor Shovel works at one of the biggest open pit copper mines in Arizona. At this location two pits are being mined: one a 4000 x 6000 pit up to 600-ft. deep; the other a new cut two miles away. Between these pits, the 27-mph Michigan commutes on its own power to handle a multitude of jobs.

Cleans up excess ore

Prior to blasting, the Michigan cleans up excess ore around the toes of the benches. It takes less than two minutes to put a heaping load into a 6-yd. dump truck. This efficient clean-up job makes for fuller breakout of material when blasting.

Delivers stemming material

No matter how hard the drillers try to dispose of the mud from the churn-type blast hole drills, trucks are often unable to get through to deliver stemming material. The 4-wheel drive Michigan easily works through the mud, delivers loads of stemming material to the powder loading points to keep shots on schedule.

Cleans up around shovels

When the crawler bulldozers come off the mine floor for repairs, the 133-hp Michigan does the clean-up work around the power shovels. Working on a new addition to the concentrating plant, the Michigan handles sand, aggregate and cement at the concrete plant. The Michigan also built a baseball diamond and part of an air strip by hauling and spreading the necessary material. Its big rubber tires even did the compacting!

A versatile work horse

With Clark torque converter, power-shift transmission and planetary-wheel axles, the Michigan Tractor Shovel delivers *more useable power and traction than you've ever seen on this type of machine.* It will handle amazingly heavy jobs—in addition to the routine assignments which affect the performance of the more expensive equipment, like power shovels, drills and rolling stock. For proof that the Michigan is in a class by itself, ask for an on-the-job demonstration. *You name the job.*

CLARK EQUIPMENT COMPANY
Construction Machinery Division
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CLARK® EQUIPMENT

Australia *(Continued)*

rate of production will mean that Australia would overtake Belgian Congo as uranium producer.

Senator Spooner added that the nuclear research reactor at present under construction at Lucas Heights, New South Wales, will be definitely completed in 1958 at a cost of about $12-million.

Inability of the present rate of production to meet the growing demand is compelling Cable Ltd. to start serious planning with a view to duplicate its Bunbury, West Australia, ilmenite plant. The plant has now reached an output rate of 5 tph and shipments in excess of 3,000 tons have already been made to Japan. Further shipments are being arranged.

At Albany, Western Australia, Hancock Prospecting Pty. Ltd. and Jackson Exploration Ltd. have completed plans to build a treatment plant for the separation of rutile, ilmenite and zircon. The two companies, operating in partnership, will also construct furnaces to start smelting ilmenite to produce iron and titanate slag. The main deposits are at Bluff River, Cheyne Beach. Technical assistance for the treatment of the slag has been arranged with firms in Germany and Japan who will be the main buyers. Primary mining operations will be carried out at the deposits while the mineral concentrate will be treated at a plant near the Albany harbor.

Western Titanium N.L., another new Western Australian producer, has increased its rate of output of ilmenite to 3,400 tons per four-week period. A further increase has already been arranged.

Assays of 95% ilmenite have been obtained in areas about 10 miles south of Mandurah, Western Australia. Further exploration work is proceeding.

Australia's big steel producer, Broken Hill Pty. Ltd. is establishing laboratories to undertake research into possible utilization of South Australian taconites and low grade iron ore deposits in the Middleback Ranges.

Coffs Harbor Rutile N.L. expects mining and production to be at full capacity in June 1957. Stockpiling of heavy mineral will begin about a month ahead of the separation plant to ensure continuity of supply. Forward sales have already been made of part of the 1957 and 1958 output. Active prospecting work has proved additional 11,000 tons of heavy mineral.

Peko Mines N.L. is still going ahead with its plans to ensure 400-tpd capacity. Copper price fall has reduced the company's profits by more than 50% and it was impossible to realize ore sales until some months after production. A total of 9,630 tons of concentrates was produced in the first six months of current fiscal year and these contained 2,451 tons of copper, 4,861 oz gold and 14,445 oz silver.

Uranium Holdings N.L. which has recently purchased rutile leases at Tewantin, Queensland, expects to have a magnetic separator plant in use before the end of 1957 and spiral plants within six months. Its latest estimates of the cost of production are between £A45-50 a ton.

Australasian Oil Exploration Ltd. reports that its main rutile separation plant at Mermaid Beach, Queensland, has commenced producion. The initially planned production rate of 10,000 tons per year is expected to be achieved in April. Forward sales of rutile have already been completed.

NEW ZEALAND

Search for payable ore in the Buller Gorge area is continuing, with the prospects "good" according to local reports. Lime and Marble Ltd., Nelson, is spearheading the search in the precipitous, bush-covered country and is now prospecting on the north side of the river, where at least seven layers of uranium-bearing rock have been located. The firm's first finds were on the south side of the Buller. Occasional ore samples have ranged as high as 5% U_3O_8.

Rio Tinto has staked some 36,000 acres in the area and Lime and Marble about 5,000. Government of New Zealand has contributed $10,000 to aid

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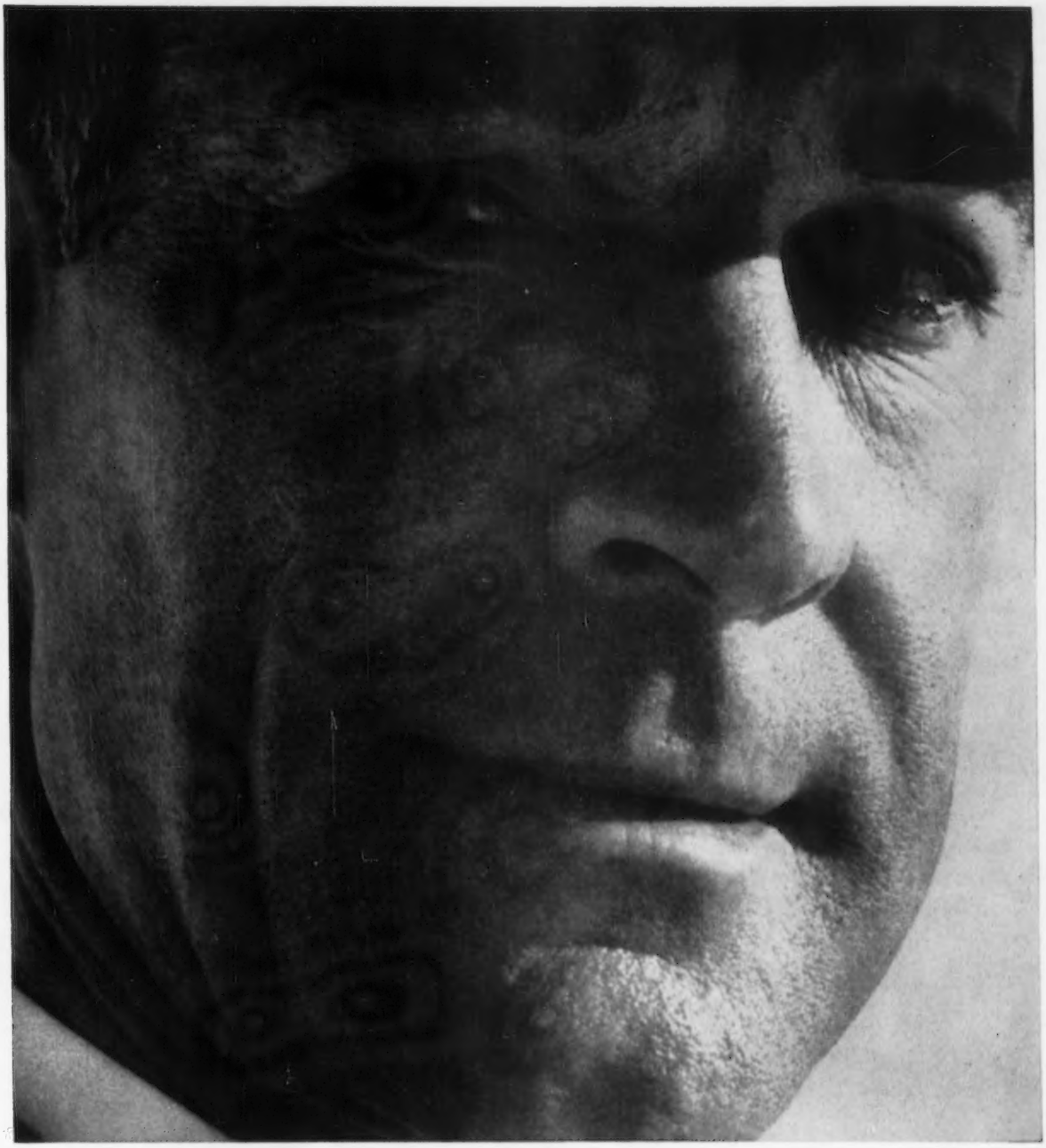

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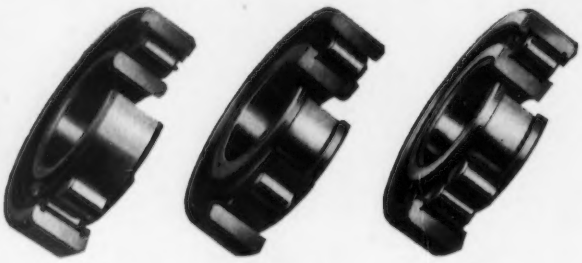
Greater capacity . . . longer life . . . or a precisely balanced gain of *both* factors. That is the choice offered you by the "crowned" rollers of Tru-Rol bearings.

By finish grinding a carefully selected crown radius on roller ends, Rollway relieves high stress areas, insures uniform distribution of load over the entire length of the roller. Rollers can take heavier loads without excessive end-fatigue, and are less subject to the effect of slight misalignment or deflection.

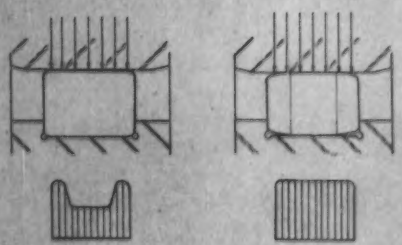
The result is load rating at higher values for greater capacity, longer service life . . . or both. If this choice interests you, why not write for the complete story. Rollway Bearing Co., Inc., 565 Seymour St., Syracuse, N.Y.

Tru-Rol Bearings with crowned rollers are available in 3 types



Stamped Steel Retainer with Guide Lips | Segmented Steel Retainer | Full Roller

Comparative Stress Patterns under Uniform Loads for Straight and Crowned Cylindrical Rollers



Stress pattern for a straight cylindrical roller under load. Note uneven end-loading.

Stress pattern for crowned roller under load. Crowning radius is exaggerated for clarity.

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Quality-built for dependable, high-output stripping and loading...

the big, rugged LIMA Type 2400

It takes a big, rugged machine like the Type 2400 to give you fast, dependable, high-output stripping and loading service. This heavy-duty 6 yd. shovel is quality-built by Lima to stay on the job, deliver peak operating performance on the tough assignments. It's easily convertible for dragline operation, too.

Air operated clutches make the Type 2400 easy to handle. Wide, long crawlers give it plenty of bearing area for stability and maneuverability on soft footing. Tandem mounted drums give maximum cable capacity. These plus Lima's quality "extras" (see right) have made the Type 2400 a hands-down favorite with users around the world.

Get the full story on the quality-built Type 2400 today. See your nearby Lima distributor, or write Construction Equipment Division, Baldwin-Lima-Hamilton Corporation, Lima, Ohio.

COMPARE QUALITY! No other machine gives you as much as LIMA!

1. Piston-type dirt seal rings and retainers in crawler rollers.
2. Moving parts are flame or induction hardened for longer life.
3. Two-shoe swing and propel clutches; air control.
4. Anti-friction bearings at all important bearing points.
5. Big capacity drums and sheaves are easy on cables.
6. Propel and swing gears and power take-off are enclosed in a sealed oil bath.
7. Torque converter (standard equipment).
8. Wherever you are, you can depend on skilled service and nearby warehouse stocks of parts to keep your LIMA on the job continuously.

COMPARE and you'll specify LIMA for shovels (½ yd. to 6 yds.), cranes (to 110 tons) and draglines (variable). Smaller capacities available on rubber.

DISTRIBUTORS IN PRINCIPAL CITIES OF THE WORLD

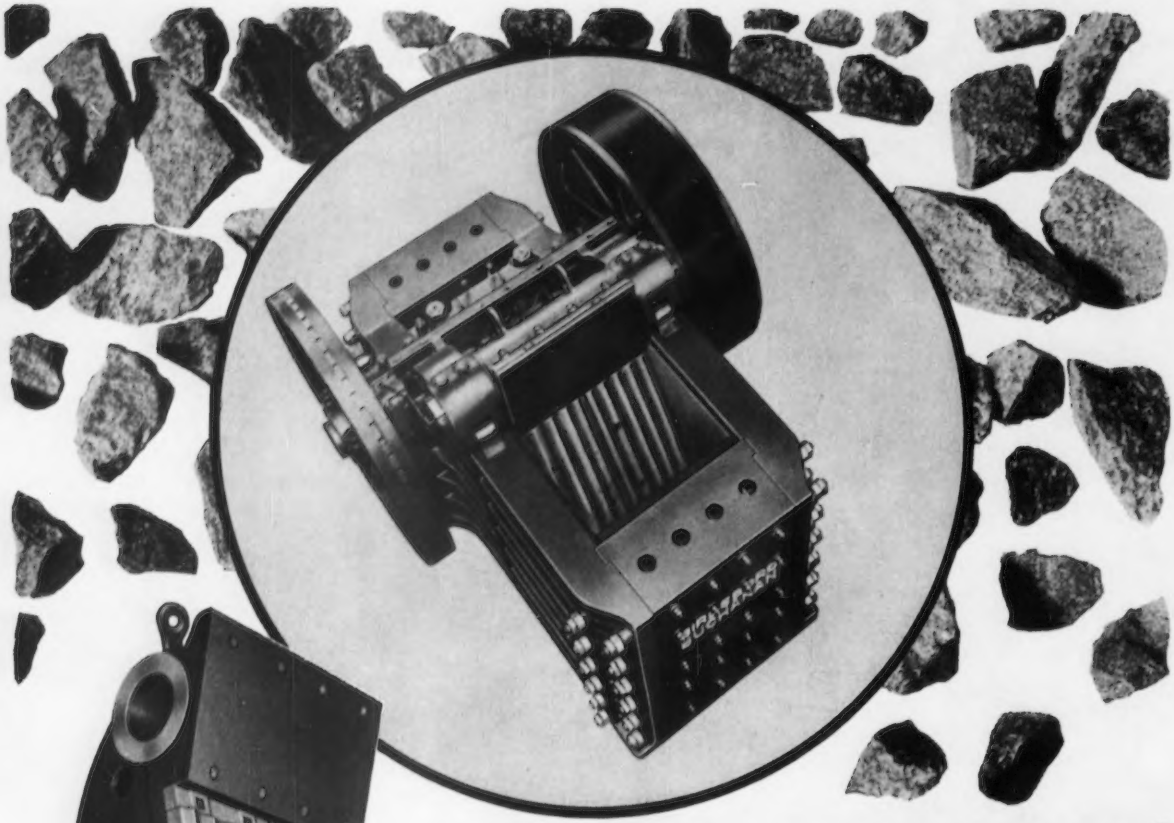
BALDWIN BLH LIMA-HAMILTON

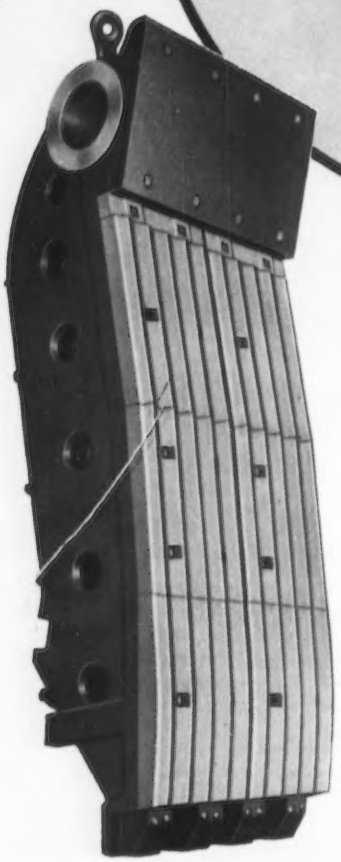
LIMA SHOVELS • CRANES • DRAGLINES • PULLSHOVELS

BALDWIN-LIMA-HAMILTON

Construction Equipment Division • LIMA WORKS

OTHER DIVISIONS: AUSTIN-WESTERN • EDDYSTONE • ELECTRONICS & INSTRUMENTATION • HAMILTON • LOEWY-HYDROPRESS • MADSEN • PELTON • STANDARD STEEL WORKS





TOUGH TISCO®

Birdsboro-Buchanan Crusher Parts

Jolting impact and punishing abrasion are the destructive one-two punch of every stone-crushing operation. Obviously, a "pretty good" steel cannot stand up consistently and profitably under this constant sledgehammer pounding. That's why impact and abrasion resistant TISCO Manganese Steel jaw plates are used in Birdsboro-Buchanan Crushers. TISCO jaw plates last longer, keep production levels high, maintenance low.

Founded in 1742, Taylor-Wharton, the Original Producers of 12 - 14% Manganese Steel in America, has the know-how and experience in making special alloy steels with top impact and abrasion resistant properties. To find out how tough TISCO Manganese Steel alloys can up the output and decrease the down-time of your Jaw Crushers and other processing equipment, specify TISCO alloys.

TAYLOR-WHARTON CO.

DIVISION OF HARSCO CORPORATION

Established 1742

HIGH BRIDGE 1, NEW JERSEY

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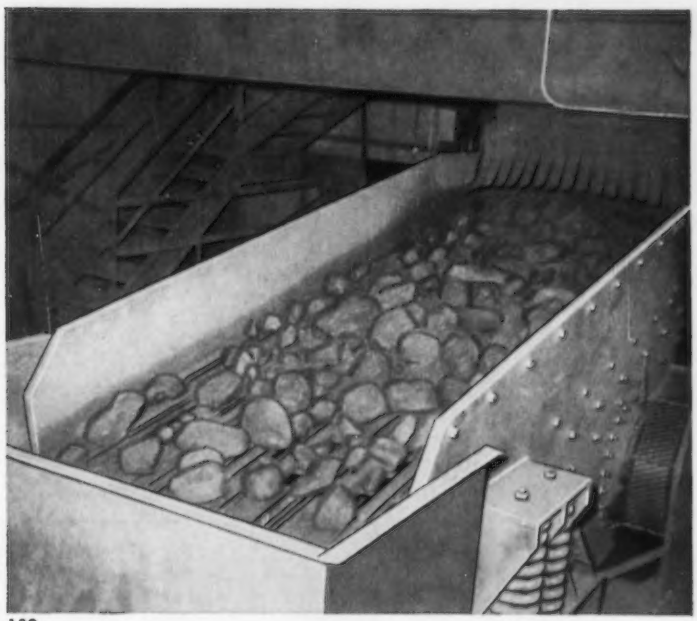
SIMPLICITY

screening methods for mines

INFORMATION ON ORE PROCESSING EQUIPMENT



189

HANDLING HIGH GRADE ORE AT CLEVELAND CLIFFS IRON COMPANY ISHPEMING MINE

Ishpeming, Mich.—SIMPLICITY heavy duty vibrating feeders and scalpers at the Cliffs Shaft Mine of the Cleveland-Cliffs Iron Company handle 350 tons per hour of high grade iron ore.

The first step in the process involves a SIMPLICITY MA-4 6′ x 16′ HD feeder, which takes the crude ore from the ore passes, then feeds it to an M-15 Simpli-Flo 6′ x 12′ scalping screen. The ore fines pass through the scalper deck onto the 5′ x 20′ and 5′ x 21′ MA-4 feeders. These feeders, set in tandem, relieve the primary crusher of fines.

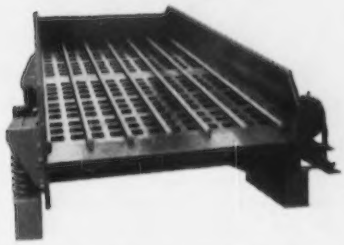
Oversize ore now passes off the scalper deck onto the 6′ x 20′ picking table, where rock and other foreign materials are removed.

Next, the picking table feeds the ore to a 42″ x 48″ jaw crusher which discharges onto the 5″ x 41′ tandem feeder. This, in turn, feeds the iron ore to a 6′ x 12′ SIMPLICITY M-15 scalping screen, where the over-size ore goes to a 4¼′ cone crusher, and then to the skip loading pocket. Fines pass through the screen deck directly to the skip pockets, relieving the flow of fines to the cone crusher.

Two 13-ton capacity skips now hoist the ore to the headframe above ground level, discharging into a bin which is above the SIMPLICITY MA-4 feeder, from which an even flow of material feeds to a belt conveyor. In the final step, the conveyor feeds the ore to the 5′ x 12′ double-check SIMPLICITY M-15 scalper, which classifies the processed ore into separate bins for loading into ore cars.

SIMPLICITY ore processing equipment is speeding ore production and reducing unit costs for the Cleveland-Cliffs Iron Company. It can do the same for you.

430 TONS TACONITE SCALPED PER HOUR



Lumps of hard, tough, extremely abrasive Taconite iron ore are scalped by this SIMPLICITY 6′ x 12′ model M-15, where it is used as both a primary and a secondary scalping unit. One plant using this equipment is operating their rugged SIMPLICITY machines 24 hours a day, seven days a week, with extremely negligible down time . . . proof of SIMPLICITY's careful design and superior construction.

QUICK-CHANGE SHAFT ASSEMBLY ON 6′x 20′ SCREEN

Big 6′ x 20′ SIMPLICITY Horizontal Screens like this one are working daily in all phases of the mining industry, such as in dewatering and "sink float" ore separation operations. In these big SIMPLICITY 6′ x 20′ units (which were the first screens of this size put into successful operation), complete shaft assemblies can be changed in just 30 minutes' time.

Write for information on any of these pieces of equipment

SIMPLICITY ENGINEERING COMPANY

DURAND 4, MICHIGAN

SALES REPRESENTATIVES IN ALL PARTS OF THE U.S.A. • FOR CANADA: Simplicity Materials Handling Limited, Guelph, Ontario • **FOR EXPORT:** Brown and Sites, 50 Church St., New York 7, N. Y.

LUBRIPLATE No. 630-AA LUBRICATES ABOUT EVERYTHING

LUBRIPLATE No. 630-AA is practically a universal grease type lubricant. It was developed to meet industries' need for *"simplified lubrication"* . . . one lubricant to effectively satisfy a great number of requirements. LUBRIPLATE No. 630-AA has a smooth, stable consistency, a wide temperature range, possesses high film strength, fine adhesive properties and is water repellent. It satisfies most lubrication requirements, thus eliminates the need for a different lubricant for each application in many cases.

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Write for free "LUBRIPLATE DATA BOOK". . . a valuable treatise on lubrication. LUBRIPLATE DIVISION, Fiske Brothers Refining Company, Newark 5, N. J. or Toledo 5, Ohio.

the local company in its search. Government and university scientists are also aiding the firm.

The reported minimum need for a treatment plant at the site is to prove 2-million tons of 0.1% ore. Local spokesmen say it will be 9 months' time before conclusive results are known. The site has the obvious advantage of nearby water, power, transportation and a harbor.

Reports *(Continued from p106)*

Freeport's sulphur production came from Grand Ecaille, Garden Bay Island, Chacahoula and Nash mines and some from the New Jersey petroleum refinery recovery plant. Progress is being made at Lake Pelto toward production.

During the year, Freeport made a deal with Humble Oil & Refining Co. to mine and operate Humble's Grand Isle sulphur deposit. A special travelling shiploader to cost $1-million will be completed at Port Sulphur

National Potash venture will produce 40,000 tpy, 60% potash.

Net profit was $13,377,585.

Steep Rock Iron Mines Ltd. shipped 3,317,073 tons of high-grade iron ore and had a net profit of $13,217,000 for the year 1956. Production target for 1957 is 3.5-million tons, with further upwards steps toward 5.5-million. Errington underground mine will lift production to 750,000 in 1957 and reach 1.5-million by 1959. By 1959 Errington open pit will be producing 1-million tpy. Hogarth underground will begin operations in 1960. In addition, the orebody leased to Inland Steel Co. is in advanced stages of production (3-million tpy output planned).

Investment in expansion during 1956 was $8,670,000.

Pittsburgh Coke & Chemical Co. had net income of $3,921,000, reporting that their cement capacity has been increased to 2-million barrels. Neville Ferro Alloy Co. was formed to produce ferro alloys

THE **BRUNTON*** POCKET TRANSIT

IT'S HANDY...
weighs only 9 oz.; 2¾" x 3" x 1⅛"; easy to carry in pocket, on belt, in car.

IT'S VERSATILE...
ideal for preliminary and supplementary surveying; used as a compass, transit, level, plumb, alidade, clinometer.

IT'S MADE TO LAST A LIFETIME
Shows direction to 1°; level, slope or grade within 1°.

"Over 60,000 Brunton Transits since 1896"

See your local engineering supply house or WRITE FOR CATALOG

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WM. AINSWORTH & SONS, INC.
2151 LAWRENCE ST. • DENVER 2, COLORADO

Nearly 50 years of World wide experience. Modern equipment. Trained crews.

CORE DRILLING
Anywhere

- Mineral Exploration
- Pre Grouting Mine Shafts
- Mine Drainage Bore Holes
- Large Diameter Holes for Ventilation and Escapeways

PENNSYLVANIA Drilling CO.
DRILLING CONTRACTORS
PITTSBURGH 20, PA.

HERE'S LOADER MOBILITY . . . EXCAVATING STRENGTH

LOADS 1½ CU YD AT A PASS . . . 2¼ yd with light materials bucket. Lifts up to 11,200 lb.

WORKS RIGHT UP ON A STOCKPILE where wheels dig in. Can build stockpiles higher, store many more yards of material in a given area.

TURNS IN ITS TRACKS . . . where many smaller loaders have to jockey.

DIGS INTO HARD-PACKED MATERIAL . . . exerts 20,000-lb break-out force, with 72 net engine hp and modern bucket design.

These are just four examples of how an Allis-Chalmers HD-6G tractor shovel offers a combination of strength, traction, flotation and mobility that enables it to replace a fleet of part-time specialized machines. You can count on it to boost production the year round. Ask your Allis-Chalmers dealer about the HD-6G . . . also the three larger tractor shovels with capacities up to 4 cu yd. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

USE BEMIS

BANG

BAGS

The EXPLOSIVE bags with 4 big advantages

- Super tough . . . resist abrasion.
- Water-resistant . . . work in a damp hole.
- Intuck design, with cemented-seam . . . they round out when filled and won't hang in the hole.
- Economical . . . the low cost will surprise you.

Bemis BANG Bags are made of the same material as Bemis Waterproof (laminated-textile) Bags, proved through years of use in many industries.

Need burlap overslips for explosive bags . . . or multiwall paper explosive bags? Bemis is your best source of these, too.

Write or wire for samples, prices and complete information.

Bemis

408-E Pine St., St. Louis 2, Missouri

Annual Reports *(Continued)*

at Neville Island, Pittsburgh, Pa.

Phelps Dodge Corp. had net income of $88,429,923. Capital expenditures were $8,563,148. Some $30-million additional expenditures have been approved and half of this amount will be spent in 1957. In addition, $8,786,000 was invested in Southern Peru Copper Corp. (16% P-D) and $9-million will be expended for this cause in 1957. Total P-D share in Southern Peru will be about $24,316,000.

Production figures	lb copper
Morenci open-pit	254,312,483
New Cornelia open-pit	132,863,848
Copper Queen underground	63,854,176
Copper Queen—Lavender pit	80,305,962
Moctezuma leaching	3,701,599
Miscellaneous	5,323,232
Total	540,361,300

Morenci removed 54,582,550 tons at 2.25 to 1 stripping ratio, while the concentrator treated 16,735,218 ton (average 52,135 tpd) and the smelter treated 490,501 ton concentrate. Molybdenum plan yielded 1200 ton concentrate.

New Cornelia removed 24,616,635 ton from Ajo at 1.43 to 1 ratio. Concentrator treated 10,092,469 tons (average 31,441 tpd) and the smelter treated 216,402 ton concentrate.

Copper Queen underground at Bisbee mined 632,088 tons, with more ore developed than removed, though no new orebody was discovered. Lavender removed 11,613,546 tons at 1.29 to 1 ratio. At present rate of over 15,700 tpd, the mine has seven years remaining in the Lavender pit. Concentrator treated 5,068,987 tons from open pit and 145,163 tons from underground, shipping 359,699 ton concentrate. Precipitation plant went into operation and reclaimed 4,810 tons of cement from dump liquor.

Douglas Reduction Works smelted 915,223 tons concentrate.

Burro Mountain exploration continues to be encouraging.

El Paso refinery has 290,000 tpy capacity, while Laurel Hill has 175,000 tons. These two refineries produced 883,510,684 lb copper, plus silver and gold, with some of the blister copper received from San Manuel Copper Corp.

Macassa Mines Ltd. milled 140,743 tons and recovered $2,008,083 in gold. Reserves were 833,167, 0.457 oz gold. Due to successful reduction in working costs, no Gold Assistance Act monies were received.

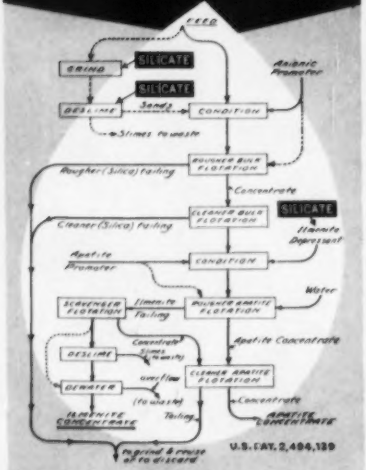
Renabie Mines Ltd. treated 153,322 tons, recovered $1,152,007 gold and had 475,648 tons, 0.232 oz gold remaining. With rebate from Gold Assistance Act, companies net income was $176,141.

Bicroft Uranium Mines Ltd. went on-stream in November at 500 tpd. Mine is now at 1000 tpd and will increase capacity to 1500 tpd in 1957.

Total net income for Macassa Mines was $604,519.

PQ SILICATE

TRIPLE AID TO RECOVERY



PQ silicates are efficient aids in complex processes of mineral separation. For example, ilmenite, fluorspar, etc. Silicates serve both as depressants and cleaners.

Ask for information about PQ silicates for improving ore recovery economically.

PQ SOLUBLE SILICATES
METSO DETERGENTS

PHILADELPHIA QUARTZ CO.
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CHEMICAL

and

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A large and expanding international petroleum company has openings for several Chemical and Mechanical Engineers with outstanding ability. This is a challenging opportunity to share the responsibility of coordinating international refining operations. Excellent advancement opportunities for applicants with a minimum of 3 years petroleum or chemical industry experience. Immediate assignment to our Far East refineries or to our White Plains Headquarters with an eventual overseas assignment. Salary commensurate with experience, liberal annuity, insurance, hospitalization and savings plans. Will pay moving and transportation expense. Please send background and experience resume to:

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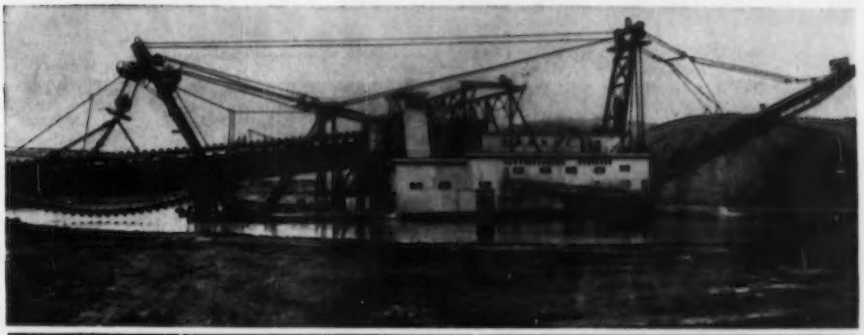
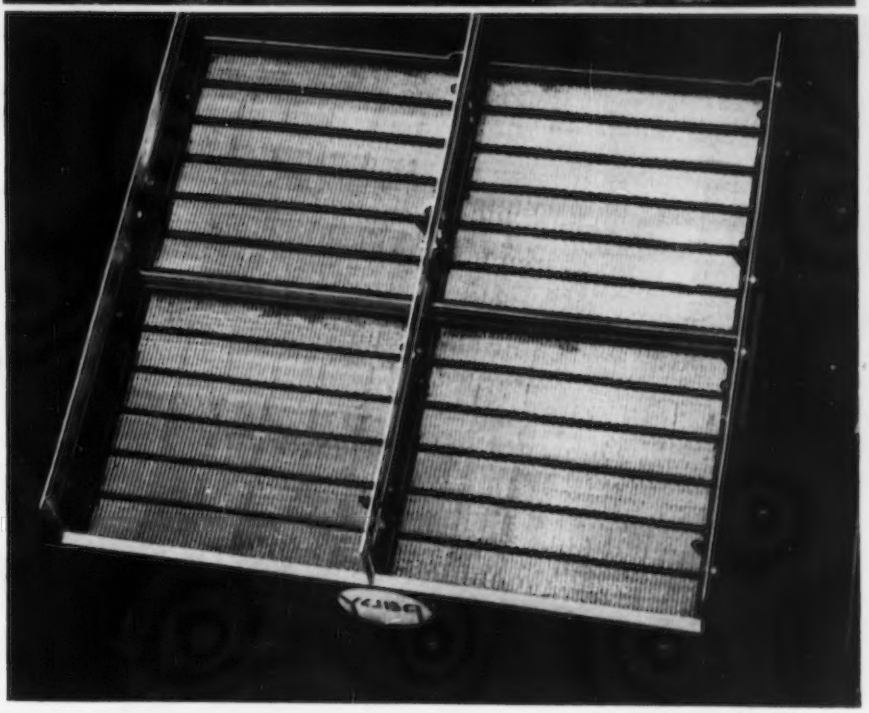
STANDARD-VACUUM OIL COMPANY
P. O. Box 1000
White Plains, N. Y.



YUBA Gold Dredge floats on self-dug, land-locked ponds. 4 of these dredges can move about 13,000 cubic yards of placer material a day. Pay dirt is separated from waste through stainless jig screens.



Type 316 Stainless Steel Jig Screens solve abrasion and corrosion problem in Yuba gold dredging operation. Even after 7 years, screen stays open, resists rust, wear, clog-up. Mineral Jig built by Yuba Manufacturing Co., Hammonton, California.

Stainless steel screens going great shakes for YUBA

Last seven years and more. No rust. No clog-up.

Water . . . black sand . . . gold-bearing gravel . . . they're all in the day's shake of mineral jigs like this.

Yet Yuba Manufacturing Co. hasn't replaced its stainless steel screens in the last seven years. What's more, they're *still* in good condition.

"Just never wears out", says H. A. Sawin, Asst. Director of Sales, speaking of the austenitic chromium-nickel steel wire used.

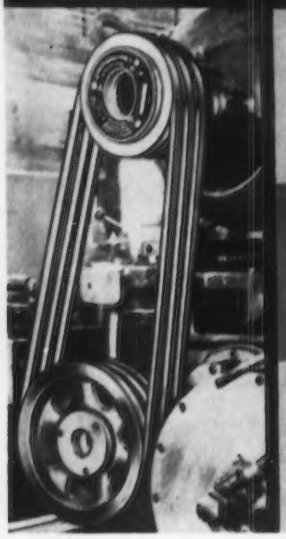
Think of what that means in replacement costs . . . in downtime saved when Yuba operates as many as 48 of these 4-screen assemblies on a single gold mining dredge!

Could be you'll make a strike with stainless in your ore processing equipment. It's light. It's strong. It effectively resists corrosion and abrasion. It pans out in performance.

You can choose from a wide variety of stainless steels to meet tough corrosion and abrasion problems. We will be happy to make a few suggestions on the right alloy for you. Just write.

INCO TRADE MARK **THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street New York 5, N. Y.

In a matter of minutes



RELEASE

ADJUST

LOCK

Quick, stepless speed variation is just this simple with American Adjustable-Diameter Sheaves, even after long periods of operation! And this is but one reason for the popularity of American Adjustable-Speed Drives. You'll also find, for example:

- First-cost is lower than other forms of variable-speed transmission.
- Less space is required than with enclosed variable-speed transmission.
- Eliminates need for large stocks of fixed-pitch sheaves to meet varying machine-speed requirements.
- Wide-range "Q", "R", and "W" section adjustable sheaves and belts offer even greater economy, transmit more power with one belt, will vary machine speeds as much as 2:1.

If variable machine speeds will increase your operating efficiency and raise your profit, you should be using American Adjustable-Speed Drives.

Stocked by distributors, almost everywhere.

a product of

The American Pulley Company
POWER-TRANSMISSION DIVISION
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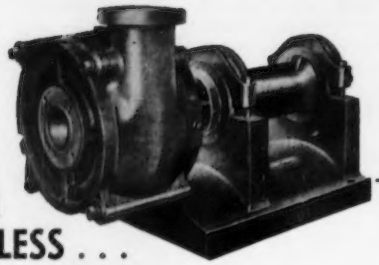
LINATEX SAND PUMPS
DEFY ABRASION . . . CORROSION



LAST LONGER
COST LESS . . .

It has been proven that:
Linatex Sand Pumps will outwear any other sand pumps in the world.
All wearing parts are covered with long lasting, abrasion resistant LINATEX.
If you are responsible for an efficient pumping operation at your plant, write for further information on the LINATEX Pump.
Made in 10 standard sizes from 1 to 12 inches.
NOTHING LASTS AS LONG AS LINATEX.

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Vernon Ave., Rockville, Conn.

RUGGED!

WITH THE NEW
SPARKLEEN® liner
. . . keeps water sparkling clear

ARCTIC BOY
portable water coolers

- Built to take abuse, for use on construction jobs, in mines, oil fields, service trucks—everywhere men work.
- Hot-dipped galvanized inset.
- Flush-mounted faucet.
- Large top opening, easy to ice, clean and fill.
- Write for further information . . . distributorships available.

THE SCHLUETER MFG. CO.
ST. LOUIS 7, MO.

DeLuxe

Big Michigan Tractor Shovel loads out 4,400,000 lbs. of open hearth slag per day

Clearing ground for the Lake Calumet Harbor near Chicago, Contractor C. J. Wilson is removing 700,000 yds. of open hearth slag dumped by neighboring steel mills. This material weighs approximately 4000 lbs. per yd., is extremely abrasive and tough to dig. With one 2¼-yd. Michigan Tractor Shovel, Wilson is loading out 110 trucks per day—10 yd. six-wheelers. That's 4,400,000 lbs. of slag per day!

Does work of 1½-yd. shovel

Wilson says that he couldn't beat this production with a 1½-yd. shovel. Calculating the hourly cost (initial cost, depreciation, maintenance, etc.), of a dragline versus the Michigan, the Michigan does the job at least 40% cheaper. With the abrasive ground conditions which prevail on the job, Wilson is naturally enthusiastic about being able to do the job on rubber-tires.

"Can't beat the front-end"

Since the first Michigan Tractor Shovel was introduced early in 1954, more and more contractors have found that this machine will handle jobs which they'd never even attempted with rubber tired equipment. Veteran crawler-loader owners, like C. J. Wilson agree that you can't beat the front-end on this machine. It will out-dig any make or type of Tractor Shovel, bar none.

Balanced power and weight

The best way to understand the Michigan's operational advantages is to watch one *ease up to a pile of tough material and come out with a heaping bucket load.* You don't have to ram the pile to get penetration. The Michigan's combination of bucket action, weight and power enables the machine to *dig its way* into the pile. 133 diesel horsepower flows smoothly through the 3-to-1 torque converter, 4-speed power-shift transmission and heavy duty drive axles right out to four big tires. Planetary gears in the wheel hub eliminate axle breakage . . . they take 70% of the torque load off the shafts.

Standard on all models

Clark torque converter, power-shift transmission and planetary wheel drive axles are standard equipment on every model in the Michigan Tractor Shovel line—1-yd., 1⅛-yd. and 2¼-yd. capacity. In each capacity, a Michigan Tractor Shovel will give you more useable digging power and traction than you've ever seen on this type of machine—faster production, lower cost per yard. For proof, ask your Michigan distributor to demonstrate—*you name the job.*

Clean design of the Michigan bucket mechanism provides good dumping clearance. Note the heaping bucket load: 40-degree low-level tip-back guarantees heaping loads of any material which can be heaped.

Michigan is a registered trade mark of

CLARK® EQUIPMENT

CLARK EQUIPMENT COMPANY
Construction Machinery Division
2465 Pipestone Road
Benton Harbor 14, Michigan

"ONE-MAN BAND"

TO DO HALF A DOZEN THINGS AT ONE TIME and do them well was the task of the one-man band, and he got the job done! Such versatility kept him always in demand because it was a departure from the conventional method.

Today, in shaft sinking, it is no longer necessary to follow conventional methods and have several men in the shaft bottom when mucking, as with a Cryderman shaft mucker and a large bucket only one man is required for the operation. Like the one-man band, he is able to do several things at once—he quickly fills the bucket, bells the hoistman, and is ready for another quick loading on the return of the bucket. Even to cleaning bottom, he does the mucking right to the last pound of muck.

With such a one-man show, the remainder of the crew is free to do the miscellaneous work always required in shaft sinking. This is a big saving in manpower that you get only with the Cryderman shaft mucker.

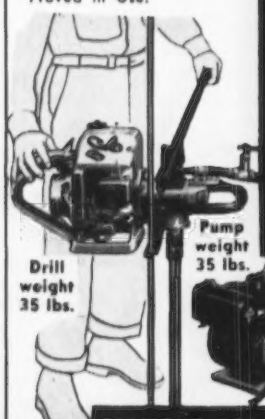
Write or Wire Us for Further Details

SHAFT AND DEVELOPMENT MACHINES, INC.

808 Newhouse Building **EMpire 3-5373** **Salt Lake City, Utah**

FOR A TRUE CORE SAMPLE IN ANY TYPE FORMATION you'll need

Lightweight Hand Portable. Goes Anywhere — by Air, Vehicle, or on Foot. Drills at Any Angle to 100° or More. Proved in Use.



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SUPER PIONEER
DIAMOND CORE DRILL

Drill weight 35 lbs.

Pump weight 35 lbs.

Basic kit complete with drill and pump
$885 F.O.B. Spokane
Drill rods and bits additional.

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NEW MANUAL ON PORTABLE DRILL OPERATION!
Complete, 24-page illustrated handbook. Price $1.

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SPRAGUE AND HENWOOD, INC.

of Scranton, Pa. and Grand Junction, Colo. as eastern and southwestern distributors of the **Super Pioneer Portable Diamond Core Drill**

We are also proud to announce the appointment of

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of New York, New York as world wide export representatives for the **Super Pioneer Portable Diamond Core Drill**

back guarantees heaping loads of any material which can be heaped.

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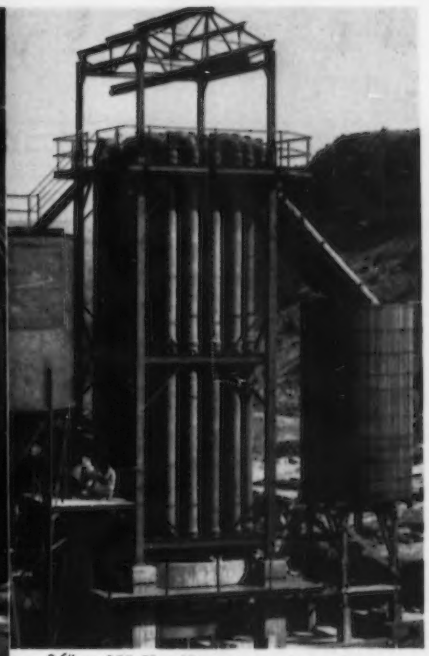
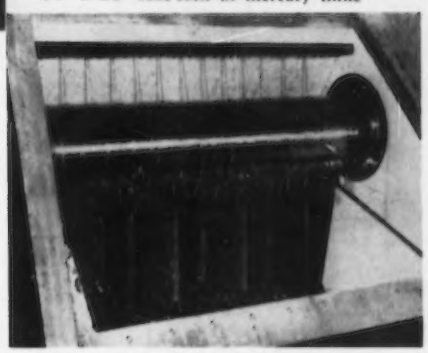


36" x 20" Kue-Ken at mercury mine

Self-lubricating KUE-KEN® *Crusher runs cool all day under full load*

LOW BEARING PRESSURES AND ENCLOSED OILING SYSTEM ARE YOUR GUARANTEE OF LOWEST OPERATING COST

Kue-Ken is the only crusher with a built-in lubrication system complete with pump and filter and sealed to keep dirt and grit out. No grease cups or fittings. This thorough lubrication permits more crushing strokes per-minute and makes Kue-Ken the highest capacity crusher size for size. See in the chart below how a Kue-Ken will supply the capacity you need in a smaller size crusher and use less horsepower. Also, you get at least 5 times longer jaw plate life. Automatic flywheel release prevents damage from overload or tramp iron. Kue-Ken is the most economical crusher to maintain and most profitable to operate.



Clean, filtered oil pouring down over shaft, bearing and toggles. With this positive lubrication, machined parts maintain their original micrometer tolerances for the life of the crusher. Only periodic oil changes are required.

Table of tons per hour that will pass through crusher with jaws set at dimensions shown when measured in the closed position.

Table is based on crushing average hard, dry quartz or similar rock weighing at least 100 lbs. per cubic foot when crushed.

Kue-Ken crusher size	¾"	1"	1¼"	1½"	2"	2½"	3"	3½"	4"	5"	6"	Horsepower range
24" x 12"	22	26	32	36	43	50	56					15 to 30
30" x 12"	32	35	38	42	55	70	76	85	110			20 to 30
36" x 10"	38	47	57	67	80	91	105					25 to 40
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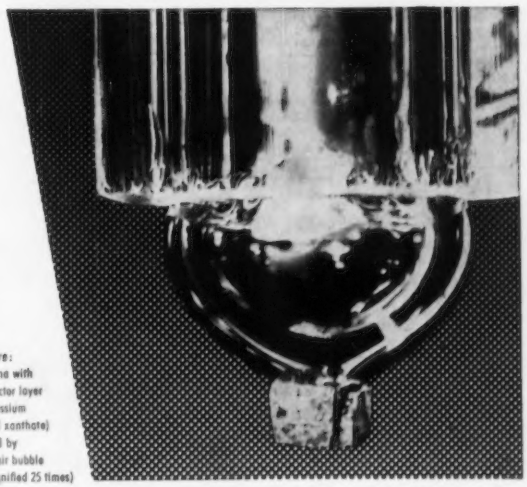

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1—Patterson 7' x 18' 2-Compartment Steel Lined
3—Patterson 6' x 18' and 6' x 22' Parax Lined
1—Allis-Chalmers 7' x 24' Compeb Mill

ROD MILLS

1—Hardinge 4' x 8' and 6' x 12' with Rods and Motor
3—Marcy 5' x 14' and 6'-6" x 14'-6"

JAW CRUSHERS

7—Blake Type—16" x 32", 18" x 36", 20" x 36", 30" x 36", 30" x 42", 36" x 42", 56" x 72", 64" x 66"
9—Single Shaft Type—10" x 20", 10" x 36" —15" x 36", 20" x 36", 24" x 36", 25" x 40", 42" x 48"
7—Cam and Roller Type—6" x 20", 9" x 15½", 10" x 20", 11" x 28", 14" x 28", 16" x 32", 24" x 40"

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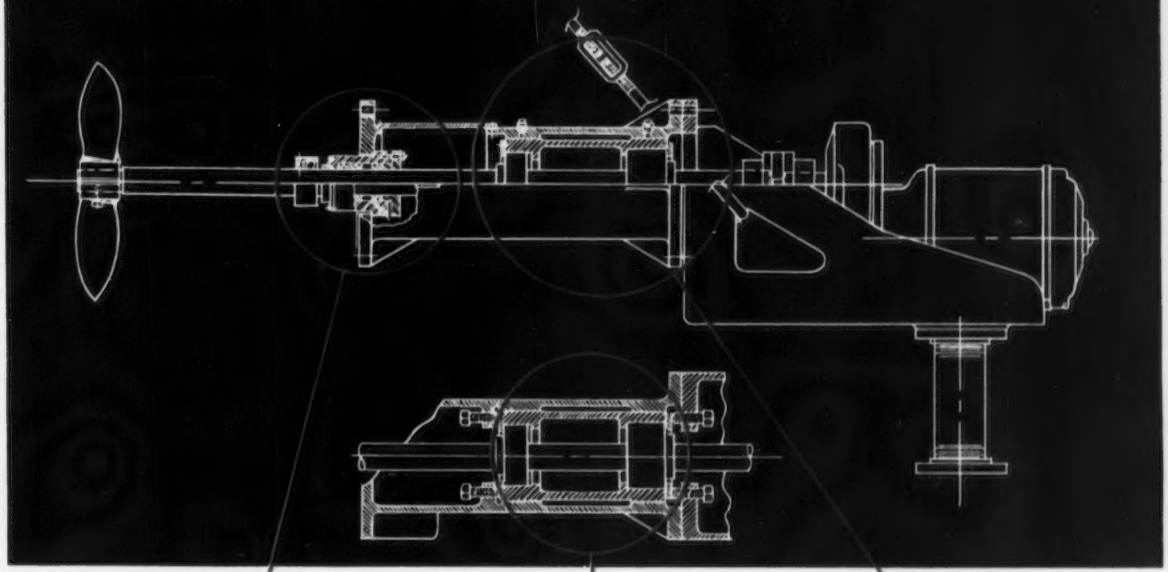

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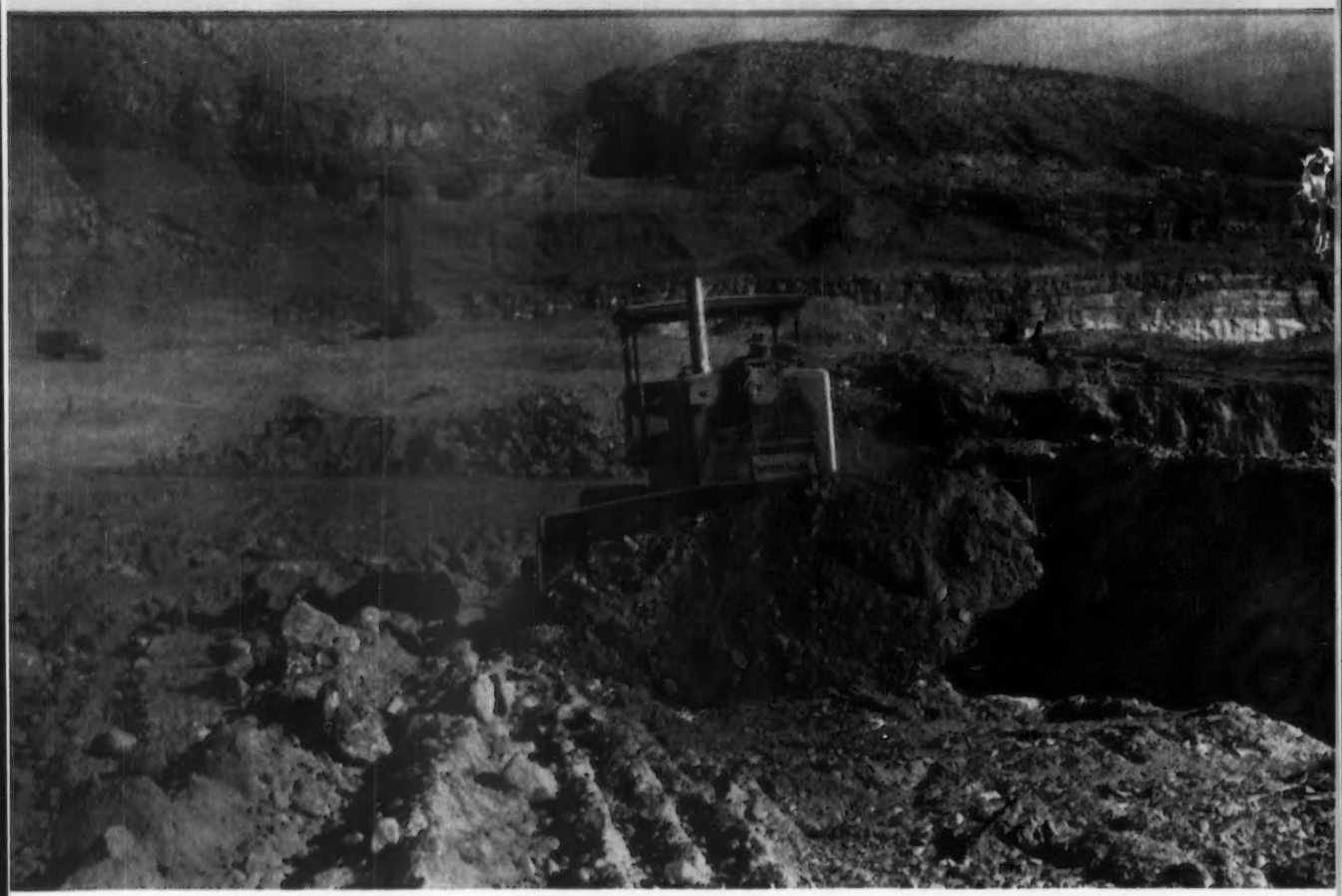

This CAT* D9 Tractor with No. 9S Bulldozer is stripping overburden from gypsum in the Blue Diamond Corporation's operation, Blue Diamond, Nevada. The material is clay and rock. Says V. D. Eachus, owner of the unit: "This D9 has done everything we have tried it on yet. It is a big tractor and it does a big job. I have owned Caterpillar-built machines now for about fifteen years and find they stand up best on the toughest of work. Our dealer service is also tops."

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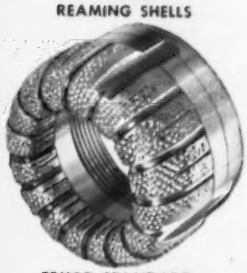
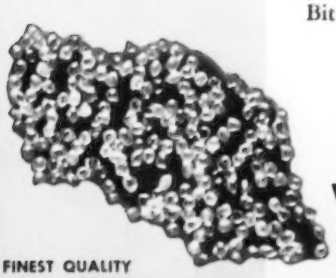
TRUCO IMPREGNATED CORING BIT

TRUCO REAMING SHELLS



TRUCO STANDARD OIL FIELD BIT



FINEST QUALITY DRILL BORTZ

SWITCH TO SPECIAL BITS PAYS OFF IN SHARPLY REDUCED DRILLING COSTS

Cost per foot drilled
DOWN 40%

Footage per hour
UP 42.8%

Footage per bit
UP 35.3%

On a dam-building job in the northwest, Truco standard non-coring bits were being used in grouting work in a hard abrasive rock formation.

Although progress was normal for this type of formation, our field engineers felt that it might be improved and set up studies of field conditions and analysis of used bits to find out whether bit performance might be bettered and if so, by what methods.

First conclusions were that more circulating fluid was required and severe abrasion around the water ways (due to the hard nature of the rock) must be overcome.

To relieve these conditions, Truco Special Cross Plug Bit No. 1 was designed and showed an appreciable improvement in performance.

However, further study showed pressure building up in the center of the bit and Truco Special Cross Plug Bit No. 2 was designed and demonstrated the substantial and continuous improvement and economies tabulated below.

The development of this bit and the resulting economies are typical of similar opportunities in many drilling operations and indicate the advantage of working with *one* organization and giving it full responsibility in developing a bit tailor-made to the job.

To the driller, the potential gain can be substantial and—money saved on drilling costs is clear profit.

If drilling costs are *your* responsibility, maybe you should talk to the Truco Diamond Drill Bit man. Very likely he can help you.

	Cost Per Foot Drilled	Footage Per Hour	Footage Per Bit
Standard bits	.72	7′	33.3′
Special Truco Cross Plug Bits	.431	10′	45′
	DOWN 40%	UP 42.8%	UP 35.3%

TRUCO DIAMOND BITS

by

WHEEL TRUEING TOOL COMPANY

3200 W. Davison Avenue, Detroit 38, Michigan

WHEEL TRUEING TOOL CO. OF CANADA, LTD.
575 Langlois Avenue, Windsor, Ont., Canada

First sheave block to take scraper "round-the-corner" and back

---turns smoothly on TIMKEN® bearings

THIS new Pacific Round-the-Corner sheave block is the first method ever devised to take an underground slushing scraper around a corner with a load, then return it around the corner to the muck pile for another load.

To keep the sheaves in positive alignment, Alloy Steel and Metals Co. engineers mount the block on Timken® tapered roller bearings. The *taper* in Timken bearings enables them to take thrust as well as radial loads or any other combination. And full line contact between rollers and races gives them extra load-carrying capacity.

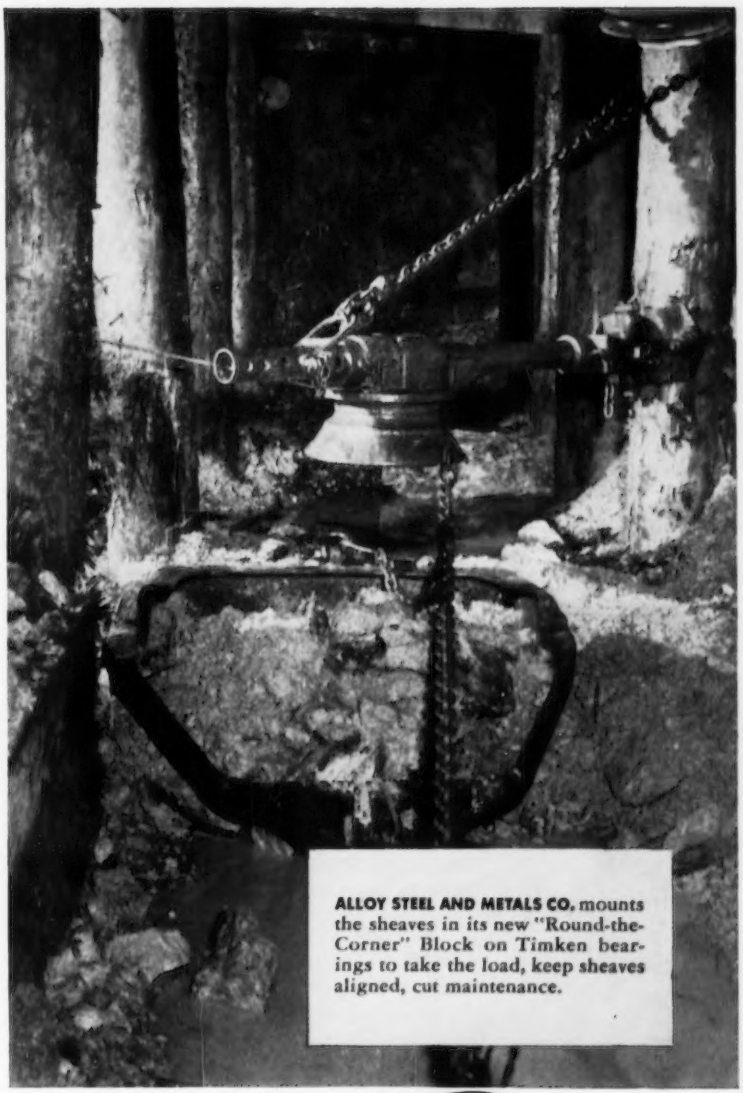
In addition, Timken bearings are almost friction-free. They are designed to have true rolling motion, and precision manufactured to live up to their design. Sheaves rotate smoothly with a minimum of wear.

Timken bearings cut lubrication expense because they keep the block's sheaves concentric with its center pin. Closures are more effective. Lubricant is kept in, dirt and moisture are kept out.

There's another reason why Timken bearings minimize costly underground maintenance for the R-T-C sheave block. Their rollers and races are case-carburized to have hard surfaces over tough cores. The hard surfaces resist wear. The tough cores shrug off shock loads. Equipment stays on the go longer.

The Timken Company is the only bearing manufacturer in America that makes its own steel. No other roller bearings give you so many advantages. Next time you build or buy a machine, make sure the trade-mark "Timken" is on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



ALLOY STEEL AND METALS CO. mounts the sheaves in its new "Round-the-Corner" Block on Timken bearings to take the load, keep sheaves aligned, cut maintenance.

TIMKEN

TRADE-MARK REG. U.S. PAT. OFF.

TAPERED ROLLER BEARINGS

ROLL THE LOAD

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ⊕ AND THRUST ⊕ LOADS OR ANY COMBINATION ⊕